



Internal Model Admissibility

Principles and criteria for internal models

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CRO FORUM

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Chapter 1 Executive summary

Internal models should cover all material risks of the company and should be consistent across all risks. Internal models should reflect the nature, scale and complexity of the underlying businesses; they should be proportional in sophistication to the materiality of the risks they cover. Materiality levels should be determined by stakeholders based on the model's purpose. Practical considerations for models include usability, reliability, timeliness, process effectiveness, systems and cost efficiency. There should be an acceptable trade-off between accuracy and the various practical constraints.

Internal models should be based on specific research and judgment reflecting management's view on how the business operates. Therefore regulation should not overly prescribe particular technical approaches or methodologies, but should focus on the governance and use of such models. Where regulations and guidelines will be put in place, they should be principles based. Systemic risk is a danger of overly prescribed methodology for internal models, as all companies would be forced to make the same decisions regarding ranking of risks.

The use test provides proof that models are used where they are designed for. This is the goal of designing a model and therefore critical. The internal model should be embedded in all key risk management and business processes, i.e. capital allocation, performance management and pricing, etc. This will be the best available review process as management will be concerned about the relative fairness of the model.

The CRO Forum believes that internal models are indispensable for managing the business. However, risk management is much more than models. Internal models must be complemented with internal controls. Finally, there is no substitute for a thorough understanding of the risks involved in the business and for common sense.

Building a Standard Model to value the entire balance sheet, and insurance liabilities in specific, on a market consistent basis is a large part of the modeling work needed for Solvency II. In principle, this is not different between the Standard Model and an Internal Model. The best estimate would therefore be largely the same, being based on best estimate cash flows of the liabilities. To give the various stakeholders of the models the required degree of comfort when using the models' results, Standard Models and Internal Models should have consistent requirements regarding governance and internal controls. For example controls around input data, non-economic assumption setting and model construction.

In principle companies should have a full internal model. This will support holistic risk management and prevent "cherry-picking" in the modeling of risks. Only if a company has a good reason (e.g. size) to have just a partial internal model they may apply for an exemption from the use of a full internal model with their supervisor. The admissibility criteria for partial internal models should be consistent with the admissibility criteria for full internal models.

The CRO Forum is pleased to offer this paper on internal model admissibility, providing core principles and practical implications for the development, use and governance of internal models. It is our hope that this contribution will strengthen the risk management practices in the (re)insurance industry.

Chapter 2 Introduction and scope

A model can be defined as a representation of an economic system. It comprises of a series of hypotheses and steps to conduct calculations or transform certain inputs into certain outputs. It is typically a tool or process, where the results are used for decision making or reporting purposes.

“Internal models” are, by definition, designed primarily for internal use and management of the business. As such management has a vested interest in ensuring the quality of such models. Further to this, with increasing external use and disclosure of the results of internal models, further guidance on internal models is appropriate.

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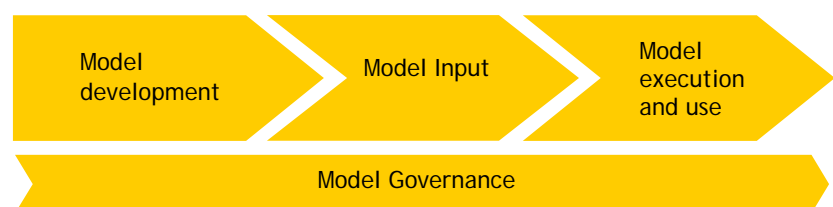
This CRO Forum (CROF) paper outlines core principles and suitable criteria for the development, use and governance of internal models. CRO Forum members should adopt these principles in their Internal Model Control Framework to give relevant stakeholders the appropriate degree of comfort in the models. This should be a sound basis for internal model admissibility.

The overall objective of this paper is to provide the principles and criteria that should result in meeting the requirements of internal and external stakeholders through effective and efficient use of firm-wide: IT applications and infrastructure; business, actuarial and risk management expertise; and sharing of knowledge and best practices.

The CRO Forum believes that internal models are indispensable for managing the business. However, risk management is much more than models. Internal models must be complemented with internal controls. Finally, there is no substitute for a thorough understanding of the risks involved in the business and for common sense.

2.1 The model lifecycle

Criteria for internal model development are described by considering the general lifecycle of a model and outlining suitable criteria per step. This should give an intuitive way of approaching internal model admissibility.



For each step in this cycle we will describe when the modeling activity or model test is properly dealt with and should pass some form of an independent review. Governance and documentation will be discussed in each step.

2.2 Solvency II

Increased attention is paid to the use of internal models within the business processes, not only by line management and its supporting functions, but also by regulators. The proposed European Solvency II Framework Directive makes explicit reference to and reliance upon internal models.

Where relevant a link will be made to the regulatory considerations and requirements outlined in the Solvency II Framework Directive. The Solvency II directive outlines six criteria for internal model approval; namely the use test, statistical quality, calibration, profit and loss attribution, validation standards, and documentation standards. It is worthwhile to note that there is a considerable interaction between these criteria. Next to these criteria, the supervisors will only approve the internal model if appropriate risk management processes are in place (Article 110 (5)), and when the internal model is appropriate for calculating the SCR (Article 100 and 101). These criteria will be discussed in the relevant sections.

Under Solvency II, subject to various conditions, (re)insurers have the option to use the Solvency II Standard Model, or their own Internal Model. Some of the principles mentioned in this paper should be applied to the Standard Model. This applies particularly to governance and controls to ensure that the Standard Model is compliant with regulations, and materially correct. Where the company uses a Standard Model instead of developing an internal model (or in cases that it has an internal model, but chooses not to use it), then a stronger application of these principles is appropriate, as the models will be relied upon to make internal and regulatory decisions.

Chapter 3 Core principles for internal models

The CRO-Forum believes that the following general principles should underlie the development, use and governance of internal models and therefore provide a solid basis for assessing model admissibility. CRO-Forum members should adopt these principles in their Internal Model Control Framework to give relevant stakeholders the appropriate degree of comfort in the models. Each of the principles is developed more fully in the remainder of this paper.

Principle 1 (Technical basis) - Internal models should cover all material risks of the company in a consistent manner. They should adopt modeling techniques and approaches appropriate to the nature, scale and complexity of the business.

Principle 2 (Dynamic nature) - Models should be dynamic and flexible in nature.

Principle 3 (Practicality and proportionality) - Internal models must be practical in the context of the organization and the model's purpose.

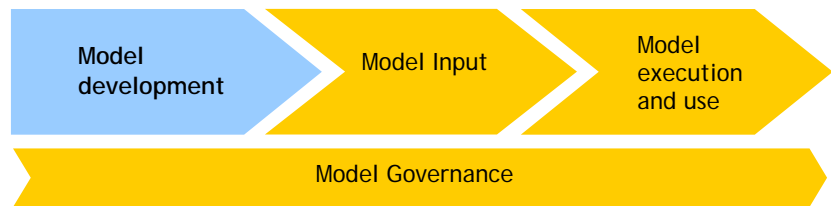
Principle 4 (Transparency and Documentation) - The insurer should document the governance, methodology and assumptions underlying the internal model and its development. Internal model results should be traceable and auditable.

Principle 5 (Use of the model) - The insurer should ensure that the internal model, its methodologies and results, are fully embedded into the financial and risk strategy and operational processes of the insurer.

Principle 6 (Governance) - The insurer should have adequate governance and internal controls in place with respect to the internal model.

Principle 7 (Independent review) - Insurers should subject their models to suitable regular independent review - internal or external depending on materiality - to validate the appropriateness of the model and be able to demonstrate that the model remains fit for purpose in changing circumstances.

Chapter 4 Model Development



4.1 Technical design

The design of internal models should be dictated by the purposes for which the model is intended to be used. It depends upon the nature, size and complexity of an insurer's risks. A firm's internal model should be integrated within its overall risk management and decision-making activities and should be used for quantifying risks and assessing a firm's economic capital.

The internal model should be applied consistently throughout the company. This will improve the comparability of business and risk and returns across the group, and in doing so, facilitate a level playing field in competition for the company's financial resources.

The internal model should be comprehensive, meaning that all material business and forms of risks should be covered. Companies should clearly state which risks / businesses are covered, which are not and giving a justification for not covering certain risks / business not covered.

Principle 1 (Technical basis) - Internal models should cover all material risks of the company in a consistent manner. They should adopt modeling techniques and approaches appropriate to the nature, scale and complexity of the business.

The technical basis should be specified appropriately and to a sufficiently detailed level to ensure that the models and the results are reproducible. To enable reproducibility of results, models should be sufficiently robust to be re-run.

An insurer should conduct a 'statistical quality test' to assess the base quantitative methodology of the internal model. As part of this test process, the insurer should be able to demonstrate the appropriateness of this methodology, including the choice of model inputs and parameters, and should be able to justify the assumptions underlying the model. Further, an insurer should conduct a 'calibration test' to demonstrate that the model satisfies the modeling criteria and thresholds specified by the stakeholders.

By definition and by design, internal models represent management's views of how the business operates, based on its own research and judgment. Therefore regulation should not overly prescribe particular technical approaches or methodologies, but should focus on the governance and use of such models¹. Where regulations and guidelines will be put in place, these should be principles based.

It is important to allow companies the freedom to develop and improve their models and risk management techniques over time. There needs to be recognition that risk models will be continuously improved as new insights in markets, consumer behavior are gained and new products are being developed. The internal model should be adaptive to new risks as they emerge. This will encourage innovation, and avoid systemic risk in the industry.

Principle 2 (Dynamic nature) - Models should be dynamic and flexible in nature.

¹ Governance is covered in chapter 7. The use test is covered in section 6.2.

Nevertheless freedom in design needs to be balanced by appropriate controls to demonstrate that models are indeed fit for purpose.

To some degree the following principles have already been accepted in Solvency II context:

- “No particular method for the calculation of the probability distribution forecast shall be prescribed”. [Directive Article 119 (4)]
- “6.30 While there should, in principle, be no limitation on the range of model approaches an undertaking might adopt for its actuarial model, subject to meeting validation and approval constraints (CfA 11.68), the supervision of internal models must not be entirely laissez faire”. [CEIOPS CP20 Further advice]
- “6.38 The ultimate supervisory reason for not requiring comparability in risk ranking is systemic risk. If all undertakings use the same ranking of risks, then all undertakings will shun the same types of risk at the same time and exacerbate market disruptions. From this financial stability point of view, diversity in risk rankings - related to diversity in the risk measures used for internal risk management - should be encouraged”. [CEIOPS CP20 Further advice]

Many of the admissibility criteria applied to internal capital models in the banking sector are appropriate for the insurance sector. However, the key differences between banking and insurance models need to be understood and reflected in revised admissibility criteria for insurance models. In this respect we could look at the approach for the use of internal models under Basel II and consider this at Solvency II. In general we believe that the Basel II approach is at times too prescriptive, and can result in models that are compromise hybrid of standard and true internal models, which may limit their usability. Experience from the banking sector indicates that investments were needed in terms of model development in order to make internal models compliant with the banking regulations.

4.2 Practicality and proportionality

Models should reflect the nature, scale and complexity of the underlying businesses; they should be proportional in sophistication to the materiality of the risks they cover. Materiality levels should be determined by stakeholders based on the model's purpose.

Principle 3 (Practicality and proportionality) - Internal models must be practical in the context of the organization and the model's purpose.

Practical considerations for models include usability, reliability, timeliness, process effectiveness, systems and cost efficiency. Some reasonable trade-off can be expected between accuracy and the various constraints.

In addition to the practical limitations mentioned above, models will always have their statistical and theoretical limitations, and can never be expected to fully replicate the real world, e.g. any statistical distribution will always have limitations on 'goodness of fit' due to limits on the number of parameters and availability of data.

Models should be fit for purpose, meaning they should be used only for the purposes for which they are designed, in other words the models should suit the purpose they are used for.

Insurance products are a combination of complex financial products (often long term with embedded options) with a large variety of insurance risks. Traditional valuation and solvency calculations are in many cases based on precise deterministic calculation models and could be determined at detailed level. The market consistent valuation and stochastic risk models require a significantly higher level of granularity in order to provide timely and insightful results.

4.3 Insurance Models

Fundamental decisions in internal model design for risk management and capital purposes are related to:

- Valuation principles
- Risk assessment/required capital metric
- Calibration standard - time horizon and confidence level

Another consideration for insurance companies is the modeling of a full simultaneous probability distribution function or modeling risks separately. Both methods have their pros and cons. Especially for underwriting risks with thin tails, where little data is available, it does not add value to develop a full simultaneous probability distribution. An acceptable approach would be to model all risks separately and subsequently aggregate the relevant capitals per risk category. This is the approach taken in the Solvency II Standard Model. It may not necessarily be applicable for risks with fat(ter) tails.

For Solvency II purposes the valuation principle should clearly be market consistency. Regarding the choice of required capital metric there are a variety of possibilities.

Solvency II sets a 99.5% confidence level over a one year time horizon as a calibration standard (Article 120 - Calibration Standards). Where an insurer can demonstrate that the calibration standard maintained in the internal model is more conservative than this and where the insurer has sufficient capital on this basis, a practical approach should be allowed to bring the internal model results to the Solvency II calibration standard.

A core component of an internal model is the modeling of the cash-flows of the liabilities and assets. Given the complexity of many insurance products, these models should be properly documented and tested.

4.4 Systems and Construction

Internal models may involve very long run times in order to perform a comprehensive risk analysis on a full portfolio of business, especially if stochastic calculations are necessary. Reduction of the calculation time can be accomplished, but may have a negative impact on the accuracy. A comparative assessment of the following can help:

- Grouping of model point data
- Deterministic instead of stochastic valuation for portfolios without options
- Closed-form formulas instead of stochastic calculation of options and guarantees
- Decrease the number of stochastic scenarios
- Time granularity
- Use of prior data files combined with scaling

The model needs to be tested to be sure that any changes in static information components and changes in assumptions all produce reasonable and reproducible results.

Another consideration is the modeling platform. Some systems lend themselves to being well controlled by limiting the range of possibilities for the modeler. On the other hand, some "open code" systems provide greater transparency, which can help the modeler diagnose errors that occur during development. Many of these systems, however, fall in the category of end-user computing applications as they are managed by the business or end-user rather than the IT organization. As such, end-user computing applications require careful risk-control considerations.

An important part of a successful development of internal models is balancing the need for documentation of evidence of controls with efficiency in model development and testing. Guidance, templates and shared examples of best practices will facilitate getting comfort that initial model development and testing is well controlled.

After design of the model, the construction phase follows. This is the physical activity of building a model. To check whether the model is constructed according to its design testing needs to be performed. Some or a combination of the following controls can be used²;

- Validate component calculations
- Test simple cases
- Add complexity incrementally
- Test selected scenarios
- Check individual or extreme cases
- Compare to other models
- Compare to published factor models
- Examine the results of various levels of aggregation

After a model has passed the stages of initial model development and construction, the modeling actuaries or risk managers can control the model through execution of a disciplined change control process. This process facilitates model integrity over time and management control over assumption changes and production results. The key to this process is to isolate and analyze changes to the extent practical. If the modeler can compare actual versus expected results for a series of stepped changes to the model, confidence can be placed in the final model outcomes. This process will still require professional judgment, since comparisons to expected results or an assessment of reasonableness is needed.

Due to their complex technical nature, models are often developed or prototyped in an “end user computing” environment. Care needs to be taken that appropriate controls are installed both in the development process and in the model execution to ensure that models can eventually be used in a production environment with an appropriate degree of confidence and security.

Model updates and change control are discussed section 7.3 and article 113 from the Solvency II Framework Directive.

4.5 Transparency and documentation

Documentation should be thorough, detailed and comprehensive enough to allow knowledgeable third parties to understand the internal model.

Principle 4 (Transparency and Documentation) - The insurer should document the governance, methodology and assumptions underlying the internal model and its development. Internal model results should be traceable and auditable.

All methodology and supporting assumptions should be clearly identified, supported and documented. The documentation should be sufficient to allow an independent reviewer to form an opinion on its compliance with all the above principles. Detailed suggestions of such documentation requirements pertaining to each part of the model life cycle are provided under the relevant sections throughout this document. Basic modeling assumptions and the model's purpose should be easily accessible to the management using the model output. An appropriate level of transparency can be reached by a suitable documentation or governance process.

² This list is taken from the draft paper by the International Actuarial Association “*Guidance paper on the use of internal models for risk and capital management purposes by insurers*”, February 13, 2008

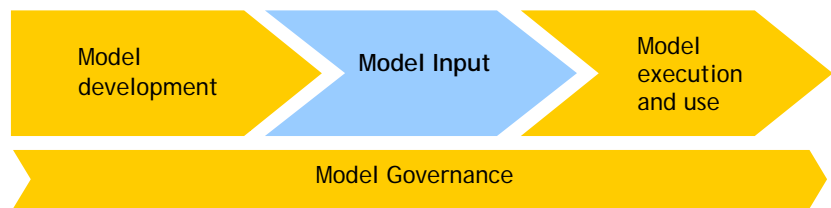
A limitative summary of most relevant documentation aspects is indicated below:

- A summary of the models being reviewed, including:
 - Uses/purposes
 - A model description
 - Relevant internal model methodology and assumptions
 - Supporting documentation including asset model, frequency and severity models, impact of reinsurance, impact of diversification, etc
 - An assessment of materiality, complexity and risk
 - Limitations of the model
 - History of the model - how, by whom and when it has been developed and tested
 - High level overview as to where the internal model may deviate from the regulatory model or a description of major differences, and the key reasons
 - Definition of the time horizon - for multi-year risk assessment the point the residual risk of the run-off becomes small enough should be identified
- Flow charts and narrative descriptions of the processes for:
 - Data management
 - Assumption setting/change
 - Model development
 - Model testing
- System specifications
- Evidence of execution of established controls, including:
 - Checklists of testing results with reviewers' initials and a written summary of findings
 - Reference to supporting materials (e.g. lists of inputs, directory with graph used in analysis/testing, results of stress tests)

Article 123 (Documentation standards) of the Solvency II Directive states that documentation should demonstrate compliance with Articles 118 - 123. It requires that insurance and reinsurance undertakings document the design and operational details of their internal model. The documentation shall provide a detailed outline of the theory, assumptions, and mathematical and empirical basis underlying the internal model. Besides this, the documentation shall indicate any circumstances under which the internal model does not work effectively.

Relevant documentation will be discussed in each of the following chapters.

Chapter 5 Model Input



Accurate model input is vital for the quality of model output. It is evident that data used for the internal model should be accurate, complete and appropriate, as confirmed in the Framework Directive (Article 119, section 3).

Below we divide the model input process into three different components:

1. Data collection
2. Data manipulation and grouping
3. Assumption setting

Required documentation should include sources of actuarial and market data, including:

- Changes from the prior set
- Reliance statements on internal/external parties

5.1 Data Collection

The asset and liability data taken into account should cover all assets and liabilities of the insurer. Reconciliations with totals from underlying administrations are useful to verify completeness. The data should reflect all material characteristics of the assets and liabilities and should be based on an economic, realistic and risk based assessment.

Data integrity checks aim to meet both management and external requirements for quality assurance. This should form a sound basis for and should facilitate management assurance sign-off (certification process). The data integrity checks should not only consider policy and economic data (e.g. market prices) feeding into the model, but also non-economic data (e.g. lapse assumptions, mortality) and documentation.

A reconciliation of internal model data with accounting data, having clear criteria for acceptance at different levels (policy, product, business line, etc.), is important.

Data integrity checks on (aggregate) policy data should include a review of the data cleansing process. In this review relevant policy data should be checked and amendments should be evaluated on possible impact on outcomes. Examples include the treatment of missing data, sense checks on date of birth, gender, maturities, duration of the policy, etc.

Key controls around information input should preferably be preventive. It is much easier and much more efficient to discover input errors before a model is run, rather than trying to diagnose the problem afterwards. Automated verification and reconciliation should be in place where possible to verify the completeness and accuracy of data or assumption changes. Disciplined execution of verification procedures can limit the exposure to information input errors flowing through to impact model results.

It should be possible to rely on controls that already have been conducted for other purposes, for instance accounting disclosures. This reliance may especially be applicable for integrity of the investment and policyholder administrations, the robustness of interfaces between different applications and key reconciliations (e.g. to IFRS figures or market data).

To facilitate effective and efficient data integrity checks, the following items needs to be documented:

- Sources of data and assumptions, including any changes from the prior set
- Evidence of execution of established controls
- Evidence of review and approval

Documentation should be in place to ensure an audit trail and evidence of principles applied and subsequent steps being taken. The depth and extent of the documentation should be consistent with the materiality and complexity of a model. If properly designed, policies provide staff with the necessary guidance as to the rigor desired by decision makers, who in turn can be confident that the modeling information is reliable and useful within the given business context and is delivered at reasonable cost.

5.2 Data manipulation and grouping

In some cases data might need to be adjusted, e.g. exclusion of outliers, or technical corrections. A clear explanation and audit trail of these adjustments should be kept.

Depending on the size of the liability portfolio and the complexity of the modeling, often aggregation of policy data is needed before calculations can be performed. This aggregation into model points is needed to avoid excessive run-times. This requisite not only applies for regulatory capital calculations, but also in application of the internal model in pricing, risk management and hedging.

Choosing the model points involve a balance between speed and accuracy. The closer the model points fit the actual policies they are representing, the more accurate the result will be. However, in general this will require a larger number of model points. The run time of models increases with the number of model points and could become practically infeasible.

When developing aggregation rules, it should be ensured that the product mix and features are represented materially the same on a grouped basis as if the model were run seriatim (i.e. policy by policy). Manipulation controls in the form of sample tests and objective criteria should be in place in order to assess whether the approximation with model points is acceptable.

The process of data manipulation and grouping should be documented, including:

- Definition of input and output data
- Description of transformation process and systems
- Justification of the level of grouping based on comparison of results for representative portfolios with clear acceptance criteria and sample tests

5.3 Assumption setting

Another set of input are assumptions needed to make projections of assets and liabilities to perform valuations and to determine required capital.

We split this type of input into the following four categories:

- Assumptions that can be observed in or derived from market data
- Assumptions for which best estimates are needed
- Management actions/policies and practices built into the model
- Other assumptions outside of management control

Assumptions should be:

- Realistic
- Applicable and relevant for the situation
- Objective
- Used consistently through the models
- Accounting for future developments

The assumptions used in the internal model should in general be consistent with the assumptions used for other purposes, while allowing for any differences in

purpose and context. There may, for example, be artificial restrictions in pricing assumptions due to regulation; these should not necessarily be carried over to the internal model assumptions.

Documentation of all assumptions should be in place to ensure an audit trail and evidence of principles applied in setting the assumptions. The depth and extent of the documentation should be consistent with the materiality and complexity.

Assumptions derived from market data

An overarching principle in Solvency II is market consistent valuation. An internal model should therefore be based as much as possible on market data for elements where deep and liquid markets exist. This also facilitates application of the internal model since for example liability valuations will be consistent with hedge costs faced in practice.

For some assets and liabilities market prices are readily available, for instance for market quoted assets and deterministic cash-flows. For other assets and liabilities market values can be derived by making use of economic scenarios. The economic scenarios should be calibrated to market prices. Assumptions derived from market data can be provided by an external party or derived with a model internally. An example of such a model is an Economic Scenario Generator (ESG).

Validation of economic scenarios can be performed by valuing instruments for which market prices are readily available with these scenarios. Documentation of the validation results and accuracy thresholds should be available for review.

Best estimate assumptions

The valuation of insurance liabilities relies for a large part on best estimate assumptions regarding future experience and policyholder behavior. In principle the uncertainty in the determination of a best estimate assumption is reflected appropriately in the risk margin of the market value of the liability. The risk margin is higher for assumptions that have a higher degree of uncertainty around the point estimation of the best estimate value, for example where assessment of the appropriateness is difficult. Extra care should be taken in cases where the change in a certain assumption has a significant impact on the overall results.

Assumptions regarding future experience should, to the extent possible, take into account:

- Company experience
- Industry experience
- Known changes in the environment and identifiable trends

In some instances, data may not be available or may be insufficient to provide a credible basis on which to develop assumptions. Consequently, it may be necessary to rely more on judgment, taking into consideration the company's pricing and/or reserving assumptions and the experience of other companies with comparable products, markets and operating procedures. Independent review and adequate evidence thereof is an important control to ensure assumptions are reasonable. In case of considerable uncertainty about projection assumptions that have a material impact on the results, separate disclosure is needed.

Experience studies need to be updated regularly to verify whether assumptions are still appropriate. As a consecutive step back testing should be performed, where the assumptions of the internal model are compared with actual experience. Clear links should exist between the conclusions of the back test and consequent steps. When substantial differences are identified remedial actions are necessary.

A structured assumption setting and updating process should be in place. For each (material) assumption the policy should contain at least the following:

- Frequency of the back test / update of assumptions
- Definition of significant differences
- Remedial actions linked to results of back testing in case of poor performance

The documentation of assumptions should allow a reviewer to evaluate the appropriateness of assumptions. Where assumptions were set using input or expertise from outside sources, the sources of such information and the reasons for reliance should be documented.

The internal sign-off process will require local management to provide a written sign-off on the reasonableness of assumptions. There are a number of goals that must be met by the (internal) sign-off process:

- Clear ownership of the assumptions
- Ability to demonstrate to the outside world that the assumptions are robust
- Manageable process given time constraints for the production of results

Management actions, policies and practices

Operating assumptions regarding management actions, policies and practices concern company policies, strategies and operations, such as profit sharing/bonus rates, expenses, reinsurance and the (re)investment strategy.

Criteria to assess the reasonableness of these assumptions include:

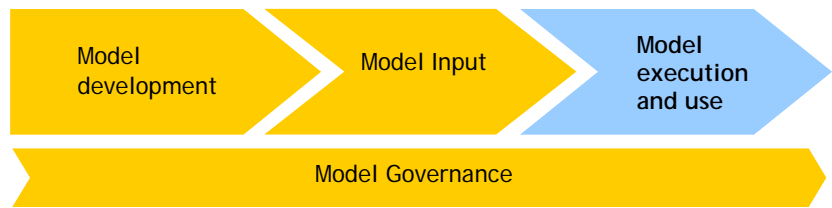
- Contractual requirements
- Inclusion in (written) policies
- The degree to which actions need prior management approval
- Past experience

Article 119.8 (Statistical quality standards) points out that insurance and reinsurance undertakings may take account of future management actions that they would reasonably expect to carry out in specific circumstances. The undertaking concerned should make an allowance for the time necessary to implement such action.

Other assumptions

Other assumptions outside management control include items such as tax rates and regulatory and tax reserving bases. For the market consistent valuation, these assumptions should reflect the actual situation as of the valuation date, as well as any known future changes, such as tax legislation due.

Chapter 6 Model Execution and use



The purpose of internal controls in the context of model execution and use is to ensure that reliance can be placed on reported model output and if errors occur, these errors are picked up timely. The preferred way of reporting is automatic processing from the model outcomes into the reporting templates. Usually programmed procedures are in place to ensure completeness and accuracy of processing model outcomes into the reporting templates. Once these procedures have been tested, together with the (independent) validation of the model, reliance can be placed on this reporting process.

6.1 Model execution

If no programmed procedures are in place, manual controls may include a checklist of consolidation tasks and inputs to ensure that all adjustments and other manual inputs are reviewed and updated, a reconciliation of model outcomes with reporting templates and previous model runs, and subsequent sign off. The review and approval procedures should be documented and an audit trail should be ensured.

The validity of model outcomes is verified by (independent) internal experts. The results need to be analyzed to ensure that results produced do reflect actual situation or deviations can be explained and understood. Internal experts can use various tools like back testing, e.g. comparing actual cash flows with projected cash flows, etc. Companies should be able to explain key features of the model as well as limitations and areas of improvement.

An indicative list of relevant quality assurance measures can include:

- Compliance with group guidelines on model development
- Reproducibility of the model outcomes
- Comparing experience to expectations from the model (assumptions used in the model)
- Alternative model calculations
- Detailed peer reviews
- Documenting of limitations of the model
- Guidance on and historical analysis of assumptions
- Technical and functional documentation requirements
- Logical checks build in the model (e.g. hash and batch totals)
- Controls embedded in the model to ensure completeness and accuracy of information feeding into the models and subsequent processing (e.g. use of decision rolls to classify model points for combining individual records into logical data groups)
- Restricted access and cell protection

6.2 Model usage

It is important that the internal model is actively used to support decision making. Internal models should be integrated into all risk management and business processes, i.e. capital allocation, performance measurement, pricing, etc. This will be the best available review process as management will be concerned about the relative fairness of the model. This may require the new regime to allow for reflection of management structures rather than legal structures, especially by focusing on the group level rather than the legal entity level. Subsidiaries should accordingly get regulatory relief if appropriate parental support is in place.

To give the empirical proof of the reliability of the internal model, the internal model should be used to support internal decision making in one or more of the following areas:

- Enterprise Risk Management (ERM) - Internal models are a prerequisite for good ERM. Therefore, this should be the first measure to assess the quality of the internal model. ERM activities encompass the consistent and objective assessment of risk across the company and decisions to keep, mitigate or transfer risks.
- Profit and loss attribution
Note: Article 121 of the Framework Directive refers to profit and loss attribution as a requirement for internal model use for regulatory capital purposes. Companies shall review, at least annually, the causes and sources of profits and losses for each major business unit. They shall demonstrate how the categorization of risk chosen in the internal model explains the causes and sources of profits and losses. The categorization of risk and attribution of profits and losses shall reflect the risk profile of the company.
- Development, pricing and profitability assessment of products
- Performance measurement and management remuneration
- Capital management, capital allocation and reinsurance programs
- Business strategy, including decisions regarding M&A and disposals
- Risk appetite and risk limits - the internal model should be used to analyze the ability to take risk and therefore serves as a basis to set risk limits and risk appetite

It is very important to keep in mind that the internal model should be used to support decision making and should not prescribe decisions. Logic and common sense should always be used to make decisions.

The Solvency II Framework Directive discusses the use test, in Article 118, as a requirement to use an internal model for regulatory capital requirements. The use test provides proof that models are used where they are designed for. In principle the use test is no more than empirical proof that the stakeholders can place reliance on the results of the model. This is the goal of designing a model and therefore critical.

To pass the use test, companies need to demonstrate the quality of their internal model is sufficient, its use is widespread throughout the company and the internal model plays an important role in the course of running its day-to-day business. The goal of the use of an internal model for regulatory capital requirements should be to align internal management practice with external solvency requirements. If the company does not act on the results of the internal model, or have an incentive to act against what internal model results imply them to do, the use test should fail automatically.

With regards to the "Profit & Loss" attribution test (Article 121 of the Solvency II Directive), it should be noted that there will be many differences due to the particular technical accounting basis adopted, which may limit the ability to perform such an analysis. Nevertheless the general principle is that financial results (under a measure consistent with the internal model definition) should be compared to the model, both to understand the financial results, and also to help in validating the model.

The 'use test' is the process by which the internal model is assessed in terms of its application within the insurer's risk management and governance processes. In order for the insurer's internal model to be most effective it should be genuinely relevant for use within its business. The internal model should be established as an integral part of the overall risk management framework. The role of risk management is discussed in specific in article 43 of the Solvency II framework directive.

Internal models should be integrated in all key risk and business processes. It is not appropriate for an internal model that is used only minimally for internal purposes, to be used for external reporting.

Principle 5 (Use of the model) - The insurer should ensure that the internal model, its methodologies and results, are fully embedded into the financial and risk strategy and operational processes of the insurer.

6.3 Treatment of partial internal models

Article 111 of the Framework Directive discusses specific provisions for the approval of partial internal models. In principle companies should have a full internal model. This will support holistic risk management and prevent "cherry-picking" in the modeling of risks. Only if a company has a good reason to have just a partial internal model they may apply for an exemption from the use of a full internal model with their supervisor.

Regulators must try to remove incentives for cherry-picking between internal and Standard Models. Article 111 recognizes this to some extent, placing an obligation to ensure that the model used is appropriate for the company's risks. Effective review and supervision of capital calculations are important here.

The proportionality principle is important to the use of partial models, meaning that the Standard Model can be applied on the basis of scale, nature and complexity. E.g. there may be certain small divisions of a large group where a Standard Model may be more appropriate (e.g. small non-EU company owned by the group), or where a particular risk is not significant, and where developing or applying an internal model may be inefficient and unrealistic. Other controls, such as the use test and ORSA should ensure that this is not abused for cherry picking.

We recognize that Standard Models are appropriate for small companies. For material risks it should be assessed whether the Standard Model is an appropriate measure. In practice companies need some time to develop internal models, to become comfortable with them, and to refine and stabilize the results. In this regard a transitional use of the internal model is reasonable, as is the development of a partial internal model as a stepping stone towards a full internal model. Small companies should have the chance to develop their internal model from the Standard Model towards a (partial) internal model. Also the use of company own data - which is actually a partial internal model - should be supported or even required (where possible). Cherry-picking should be addressed during the model review process.

For companies using a full internal model the use of partial internal models should be allowed in the processes of mergers & acquisitions, disposals or start ups. In case of material risks, a transition plan is a prerequisite.

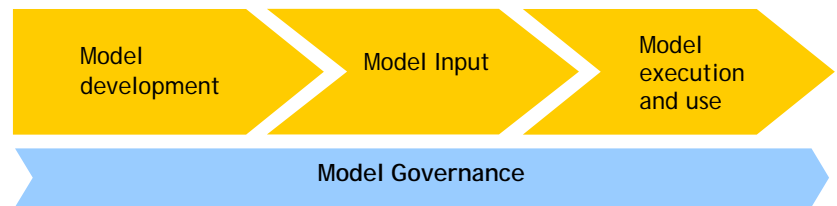
It is important to realize that the development of a Standard Model also requires significant effort. Building a Standard Model to value the entire balance sheet, and insurance liabilities in specific, on a market consistent basis is a large part of the modeling work needed for Solvency II. In principle, this is not different between the Standard Model and an Internal Model. The best estimate would therefore be largely the same, being based on best estimate cash flows of the liabilities.

Standard Models and Internal Models should have consistent requirements regarding governance and internal controls. For example, the standards regarding setting of input and assumptions, processes and review of the models should be similar. The admissibility criteria for partial internal models should be consistent with the admissibility criteria for full internal models.

In addition companies should document their grounds for choices made in decisions to use an Internal Model or a Standard Model for certain risks or parts of the business. Companies should as a minimum assess for their biggest risks whether the Standard Model is appropriate. If this is not the case, an Internal Model should be developed. In decision which parts of the business to model with an Internal Model, materiality should be considered; meaning that it is expected that the biggest risks would be the first in line to be modeled by an Internal Model. Also it is expected that choices to be consistent over the course of years.

It is likely that there will be differences in results between the Standard Model and Internal Models. This is to be expected due to the limitations of the Standard Model. This does not invalidate the internal model, and should not be grounds for any add-on. Nevertheless reasons for major differences should be identified, as this contributes to understanding the rationale and validity of the internal model versus that underlying the Standard Model. In some cases fundamental differences will limit the granularity of such reconciliation, and this needs to be handled on a practical case by case basis.

Chapter 7 Model Governance



Insurers should have an overall model governance framework. The wider governance framework should address all of the following components:

- Model definition
- Model methodology
- Primary controls
- Model development
- Model changes
- Model usage
- Resources
- Compliance
- Model review processes
- Regulatory approvals
- Organizational structure
- Documentation standards

Principle 6 (Governance) - The insurer should have adequate governance and internal controls in place with respect to the internal model.

7.1 Model review

Internal models should be independently reviewed. The types of review required should be appropriate to the nature, scale and complexity of the business. Suitable independent review could be internal as well as external.

Principle 7 (Independent review) - Insurers should subject their models to suitable regular independent review - internal or external depending on materiality - to validate the appropriateness of the model and be able to demonstrate that the model remains fit for purpose in changing circumstances.

A distinction should be made between at least the following three lines of defense:

Primary controls - Meaning controls established by the primary owners and users of the models. These controls are typically embedded in the processes themselves, e.g. system acceptance testing, data and result consistency checks, alternative calculation reasonableness tests, management sign offs, etc.

Internal reviews - Reviews conducted by internal, independent resources.³ This internal requirement is important to ensure alignment of ultimate objectives, familiarity with the organization, and enterprise wide consistency and standards. The independence requirement is important to ensure objectivity of the review. Typically this includes reviews by an organization's internal audit function, while some companies have also set up model validation departments to conduct more technical independent reviews of models.

³ If insufficient independent resources are available, more reliance should be placed on external review.

External reviews - These reviews are conducted by a fully independent third party. External reviews would include especially supervisory approval. These should be realized by the right interaction between the internal model validation team and the external reviewer.

In the context of Solvency II, supervisory review is by definition an external review, and therefore does not imply that another external review (for example by an audit firm) should be required for regulatory approval.

All reviews should be carried out with well defined purpose, scope and approach: It is reasonable for higher level reviews to rely on lower level reviews, that the higher level reviewer has sufficient confidence in the lower level review. In practice this means that the higher level review should confirm the scope, purpose, approach, transparency, results, timing and limitations of the lower level review. It may also include sample checks of items previously reviewed, as well as secondary reviews of more material items.

It is reasonable for "same level" reviews to be clearly scoped such that gaps are eliminated, and overlaps minimized, e.g. an internal review can be split into technical statistical validation and a more general review on processes and internal controls.

Any review process should be conducted in a practical manner including appropriate planning and interactive communication. The scope and approach should be determined based on the principles described above and communicated in advance. The review process should be practical, allowing for interaction discussion with modelers, time for iterations of the review, corrective actions or alternative arrangements. The review itself should be subject to appropriate documentation, reporting and communication standards.

Principle 1 allows some freedom in the design of models. It follows that reviews will be to some extent subjective, but based on professional opinion. In this regard allowance must be made for discussion of differences of opinion and development of opinions.

Ultimately any review of a model needs to be judged on an aggregate substantive basis. A perfect score against all criteria should not be seen as the condition for review approval. Reviewers should have necessary expertise and qualification, at least similar to those designing and executing the models. Ideally, the persons performing model reviews should be as independent as possible from the persons who constructed and/or executed the model. The degree of independence will depend on the purpose of the review and consider the interests of the reviewers and the relevant stakeholders.

7.2 Model validation

There are three generic procedures that are applicable when validating a model:

1. Review of the logical and conceptual soundness
2. Comparison against other models
3. Comparison of model predictions against subsequent real-world events

Depending on the circumstances, any or all of these procedures should be separately applied to each of a model's three components, i.e. the information input component, processing component and reporting component.

Comparisons with other models (market best practices) that suit the same purpose can be helpful in considering alternative approaches, but should not be used blindly, as it may encourage "herd mentality" and systemic risk.

As part of the review of the logical and conceptual soundness of models, stress tests can be performed. A stress test is a "what if" scenario that takes the internal model and all its assumptions as given but assumes a major change in one or more variables in order to see what effect this would have on various indicators. Benchmarking is a standard by which something can be measured or judged. In the context of internal model validation, it can be a validation tool for example by

checking whether the market consistent price of an option seen in the market can be replicated by the model or whether the value of a unit linked policy is the same in this model as in another model.

Properly designed, formal validation policies provide staff with the necessary guidance as to the rigor desired by decision makers, who in turn can be confident that the modeling information is reliable and useful within the given business context and is delivered at reasonable costs.

The criteria in this section apply for the data and assumptions that feed into the models (the information input component), the model that transforms these inputs into estimates via computer instructions (processing component) and the reporting component which translates the mathematical estimates into useful business and disclosure information. Documentation, quality of controls, information technology and analysis of model results are all important to obtaining a robust assurance that the internal models are suitable for their purposes.

A structured risk analysis of internal models should be in place to evaluate the required level of (independent) review of models and subsequent reporting thereof to appropriate risk committees and/or line management. The validation requirements should be more robust for high-risk models requiring more expertise, higher level of independence and higher documentation standards. Various levels of sign-off are needed to establish the integrity of results and operating effectiveness of internal model controls. Reliance can be placed on controls performed by others for ensuring the completeness and accuracy of assumptions used as inputs to the model.

Model reviewers must have sufficient expertise to validate internal models and/or results. Model reviews should be performed and documented sufficiently to demonstrate it is effective and provides the required level of quality assurance. These goals need to be balanced, especially considering that neither resources nor time are infinite.

The different types of internal reviews can include management reviews, peer reviews, and independent reviews by a model validation team or similar function. It should be noted that these reviews are not intended to be equal. They are cumulative in the sense that prior reviews will add information that will be used to support later and/or more independent reviews. Strong modeling groups may naturally perform and document peer and management reviews as part of their working procedures.

Article 122 sets out the following validation standards;

- Insurance and reinsurance undertakings shall have a regular cycle of model validation which includes monitoring the performance of the internal model, reviewing the on-going appropriateness of its specification, and testing its results against experience.
- The model validation process shall include an effective statistical process for validating the internal model which enables the insurance and reinsurance undertakings to demonstrate to their supervisory authorities that the resulting capital requirements are appropriate.
- The statistical methods applied shall not only test the appropriateness of the probability distribution forecast compared to loss experience, but also to all new data and information relating thereto.
- The model validation process shall include an analysis of the stability of the internal model and in particular the testing of the sensitivity of the results of the internal model to changes in key underlying assumptions. It shall also include an assessment of the accuracy, completeness and appropriateness of the data used by the internal model.

Documentation should evidence steps taken during the validation process, level of expertise of (independent) validators, findings and conclusion of review, subsequent reporting and decision making by relevant line management or risk committees. With an eye to efficiency, companies should strive that the documentation produced in the model development stage can be a sound basis here.

7.3 Model updates and change control

Models should have some flexibility within their operation, and there should be allowance for changes over time. However it is equally appropriate that appropriate governance and controls exist on such changes.

Quantitative models will always run behind qualitative understanding. There is always likely to be some qualitative considerations which are not fully reflected in the mathematical models. As models are a representation of the 'real world' there should be allowance for justified qualitative adjustments to model results and the interpretation of the results given appropriate governance is in place.

As already pointed out in the CRO Forum Benchmarking Study on Internal Models, an internal model must offer a high degree of adaptability to new products, new risks and market changes. We consider that a clear process should be in place for approval of model changes.

The internal model is subject to regular renewals. Rules based criteria cannot capture this dynamic aspect of internal models. Principles based requirements are therefore needed: the regulator should set the broad objectives and criteria for an internal model, leaving the detailed guidelines to be set and disclosed by the company. Changes that lead to material capital changes should be documented and reported to regulators. The industry should prove to be able to establish robust frameworks around models enabling supervisors to place reliance on these frameworks.

Changes in a model need to be tested before the model is used. It should be evaluated how the control process facilitates the model integrity over time and facilitates management control on assumption changes and production results.

With respect to change documentation, the Framework Directive points out in article 123 that insurance and reinsurance undertakings shall document all major changes to their internal model, as set out in article 113.

Major changes to internal models should be documented, at least including:

- Date of the changes
- Description of the changes
- Testing results
- Review and approval

In addition a frequency for model review should be documented.

Appendix 1: List of references

Author	Date	Title
European Commission	Feb 2008	Draft directive
Council of EU	Dec 2008 (latest)	Draft directive proposed amendments
European Parliament	Oct 2008 (latest)	Draft directive proposed amendments
CEIOPS	Mar 2007	CP20 Pillar I - Other issues consultation
CRO Forum	Jan 2007	Comments on CP20
CEIOPS	12 Jan 2009	Stock-taking report on the use of Internal Models in Insurance (CEIOPS-IntMod-01/09, 12 Jan 2009)
CEIOPS	March 2009	CP37 Draft Advice on Level 2 Implementing Measures the procedure to be followed for the approval of an internal model (March 2009)
CEIOPS	3 Nov 2008	Implementing measures on Systems of Governance (CEIOPS-IGSRR-24/08, 3 Nov 2008)
IAIS	Oct 2008	Standard on the Use of Internal Models for Regulatory Capital purposes (Standard 2.2.7, Oct 2008)
IAIS	Oct 2008	Guidance on the Use of Internal Models for Regulatory Capital purposes (Standard 2.2.6, Oct 2008)
Basel Committee on Banking Supervision	June 2006	International Convergence of Capital Measurement and Capital Standards - Revised Framework (Comprehensive version) Part 2 - First Pillar Minimum Capital Requirements III Credit Risk - Internal; ratings approach V.B.3 Operational Risk - Advanced Measurement Approach VI.D market Risk - Internal model approach
UK FSA	Sep 2008	The path to Solvency 2 - DP04/08
KPMG		** Solvency Model Validation approach
PwC		** Countdown to Solvency II - Article 03 "Trusting the numbers: the development application and approval of internal models"
ING		** Model Validation standards of Practice
Life & pensions	December 2008	Articles: "Internal Models - A stamp of approval", and "Systems for Solvency II- Model behaviours"
IAA	13 Feb 2008	Guidance paper on the use of internal models for risk and capital management purposes by insurers (DRAFT)
AEGON		** AeMcS Internal Control Framework

** Some of the documents are not publicly available or may be proprietary / copyrighted, and may therefore not be available for review.

Appendix 2: Solvency II Framework Directive Summary

Article 45 of the draft directive covers the internal control system, with mention of:

- Need for an internal control system
- System should comprise at the least: administrative, accounting, internal controls, reporting and compliance arrangements
- Scope of compliance function as key component of an internal control system

Article 46 covers the internal audit function, with specific mention of:

- Need for an internal audit function
- Role includes evaluation of the internal control system
- Independence
- Importance of audit recommendations

Articles 100-123 of the Solvency II draft directive include six clear criteria for regulatory approval of internal models. These are (in summary form):

1. Use test

- Demonstration of internal widespread use
- Role in risk management governance and decision making
- Role in economic and solvency capital allocation
- Frequency of use
- Appropriateness of the model

2. Statistical quality

- Adequate statistical and actuarial techniques
- Consistency with technical provisions
- Current and credible information
- Realistic assumptions
- Ability to justify assumptions to authorities
- Data accuracy, completeness and appropriateness
- Yearly update of data
- Non prescription of any particular distributions
- Cover all material risks
- Cover all risks explicitly mentioned under Solvency II framework
- Allowance for diversification is permitted
- Allowance for risk mitigation techniques is permitted
- Special attention to options and guarantees
- Allowance for future management actions
- Specific allowance for non guaranteed payments

3. Calibration

- Allowance for different time periods of assessment provided broadly equivalent
- Capital requirements derived directly from probability distributions where possible or else approximations can be used if equivalent protection is demonstrated
- Supervisors may request validation against external data

4. Profit & loss attribution

- Annual P&L attribution required
- Risk classification to be related to attribution analysis

5. Validation standards

- Regular cycle of validation required, with scope: monitoring performance, appropriateness of specification, testing results against experience
- Effective statistical process to demonstrate appropriateness
- Statistical methods should also apply to material new data and information
- Analysis of stability of model, sensitivity of results
- Accuracy, completeness and appropriateness of data

6. Documentation standards

- Sufficient to demonstrate compliance with all above tests
- Theory, assumptions, mathematical basis and empirical basis
- Limitations of model
- Change history to be documented

[Extracted from Issues paper - Implementing Measures on System of Governance, 3 Nov 2008, CEIOPS-IGSRR-24/08]

Internal Control System

7.32. The internal control system shall secure the undertaking's compliance with applicable laws, regulations and administrative provisions and the effectiveness and efficiency of operations in view of its objectives as well as the availability and reliability of financial and non-financial information.

7.33. The undertaking shall be required to have in place a suitable control environment, appropriate control activities, effective information and communication procedures and adequate monitoring mechanisms.

7.34. The compliance function shall not be placed in a position where there is a possible conflict of interest between its compliance responsibilities and any other responsibilities it may have.

7.35. The compliance function shall have appropriate standing within the undertaking.
It shall be able to communicate on its own initiative with any staff member and to obtain access to any records necessary to allow it to carry out its responsibilities.

7.36. The intended compliance activities shall be set out in a compliance plan that ensures that all relevant areas of the undertaking are appropriately covered, taking into account their susceptibility to compliance risk.

7.37. The compliance function shall promptly report any major compliance problems it identifies to the administrative or management body.

Internal Audit

8.15. To ensure its independence from the organizational activities audited, the internal audit function shall have an appropriate standing within the organization and carry out its assignments with impartiality. The internal audit function shall be able to exercise its assignments on its own initiative in all areas of the undertaking. It shall be free to express its findings and to disclose them and its appraisals to the whole administrative or management body.

8.16. The internal audit function shall have the complete and unrestricted right to obtain information, which includes the prompt provision of all necessary information, the availability of all essential documentation and the ability to look into all activities and processes of the undertaking, relevant for the discharge of its responsibilities, as required in the performance of its tasks, as well as having direct communication with any member of the undertaking's staff.

8.17. To ensure the effectiveness of the internal audit function, every activity and every unit of the undertaking shall fall within its scope. The function shall draw up an audit plan to determine its future auditing actions, taking a risk based approach in deciding its priorities.

8.18. The internal audit function shall at least annually produce a written report on its findings to be submitted to the administrative or management body. The report shall cover at least any deficiencies with regard to the efficiency and suitability of the internal control system as well as major shortcomings with regard to the compliance with internal policies, procedures and processes. It shall include recommendations on how to remedy inadequacies and also specifically address how past points of criticism and past recommendations have been implemented.

Appendix 4: Scope and definition of model validation

The term “validation” has been used in a variety of contexts in regulation, and in practice, and so we provide some additional notes on this below:

- A narrow definition of “validation” would be statistical testing of a model by reference to actual experience results or by reference to external data. This is part of the natural control cycle, and may be considered as a primary control.
- A wider definition of “validation” would be an independent review of overall appropriateness of model, but using statistical expertise and techniques. This would be conducted by an independent function or party, and would include challenging the fundamental assumptions of the model. It may also extend to certain audit functions, such as review of the data and systems. This definition would be covered under the scope of (independent) internal reviews.
- The meaning under Solvency II appears to cover more of the first narrower definition. (This text is reproduced below).
- The meaning under Basel II encompasses more of the second wider definition, and this appears to be the actual practice of major industry players, who have established model validation functions.
- Note: the wider definition of “model validation” would typically also include a review of any statistical validation, resulting in some confusion and overlap of the definitions in practice.
- Both these functions are important as part of the control cycle, but given the potential for confusion, we advise clear definition of term validation whenever it is used.

The following text is extracted from Solvency II Directive (Article 122 - Validation standards).

- Insurance and reinsurance undertakings shall have a regular cycle of model validation which includes monitoring the performance of the internal model, reviewing the on-going appropriateness of its specification, and testing its results against experience.
- The model validation process shall include an effective statistical process for validating the internal model which enables the insurance and reinsurance undertakings to demonstrate to their supervisory authorities that the resulting capital requirements are appropriate.
- The statistical methods applied shall not only test the appropriateness of the probability distribution forecast compared to loss experience, but also to all material new data and information relating thereto.
- The model validation process shall include an analysis of the stability of the internal model and in particular the testing of the sensitivity of the results of the internal model to changes in key underlying assumptions. It shall also include an assessment of the accuracy, completeness and appropriateness of the data used by the internal model.

Appendix 5: Banking versus insurance approach

It is useful to look at the approach for the use of internal models under Basel II, in contrast with Solvency II. The primary reference is the consolidated Basel II consolidated framework issued in June 2006.

- The Basel II framework makes provision for internal models for credit risk, operational risk and market risk. Descriptions and requirements for each are slightly different, but do follow the same general principles
- The Basel II framework gives a fairly detailed framework for internal models, specifying sub risk classifications, and describing certain approaches and options available
- The Basel II description of validation generally follows the wider “independent review” scope mentioned above
- Adoption of the framework by individual countries has led to further differences and detailed regulation at the operating entity level

In general we believe that the Basel II approach is not suitable for Solvency II. The degree of regulation on methodologies is too detailed and prescriptive, with the result that the models are a hybrid of standard and true internal models. This compromise could result in models that are neither simple, nor fit for purpose. Experience from the banking sector indicated an investment was needed in terms of model development in order to make their internal models compliant.

The description of validation processes also goes into some detail. However these principles are generally quite reasonable, and follow a principle based approach. Overall these conditions are reasonable in the context of the overall control system of insurers’ solvency models. However direct application of these principles in the Solvency II context needs to be handled carefully, since “validation” is defined more narrowly in the Solvency II directive than it is under Basel II.

It is also important to consider some fundamental differences between the banking sector and insurance sector when considering the detailed regulations. These include:

- Complexity of liabilities
- Different typical mixture of assets
- Different ALM relationships
- Time horizons
- Relative importance of the different risk categories
- Organizational and legal structures

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