

Internal Model Industry Forum:

# A sustainable operating model for validation

Internal Model Industry Forum

Supported by:



# Contents

<b>Foreword</b>	<b>1</b>
<hr/>	
<b>Introduction</b>	<b>2</b>
Emerging discipline in a moving regulatory environment	3
Model assurance	3
<hr/>	
<b>People</b>	<b>4</b>
Responsibility for validation	4
Internal and external resourcing	5
<hr/>	
<b>Operations</b>	<b>6</b>
Validation approach and processes	6
The tools of validation	7
Validation infrastructure	7
Approach to model change	8
Annual timetable	9
<hr/>	
<b>Governance</b>	<b>10</b>
Board engagement	10
Validation report	10
Key elements of board communication	11
What does good governance look like?	12
<hr/>	
<b>Case Studies</b>	<b>14</b>
Case Study 1: Example internal model validation governance structure	14
Case Study 2: Leveraging the governance process	16
<hr/>	
Appendix A – Validation approach	18
Appendix B – The tools of validation	20
Appendix C – Validation report	23

©2015 The Institute of Risk Management.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise without the express permission of the copyright owner. Permission will generally be granted for use of the material from this document on condition that the source is clearly credited as being the Institute of Risk Management.

IRM does not necessarily endorse the views expressed or products described by individual authors within this document.

# Foreword



Capital models are a valuable and sophisticated tool, but like all complex tools, they need to be trusted and understood by the different stakeholders and in particular the firm's Board. Validation is a key tool to help the Board understand the strengths and weaknesses of the model, and provide an independent view on the outputs, key limitations and overall appropriateness for use. The actual validation activities need to be based on a cost effective and robust process that not only builds trust with stakeholders (including the regulator) but also adds value to the business.

This booklet is part of a series being produced by the Internal Model Industry Forum (IMIF) offering guidance on the validation, communication and use of insurers' internal capital models as part of the Solvency II implementation. In particular, this booklet sets out the findings of our workstream looking at all aspects of internal model validation governance and the related operating model, including the systems, processes and controls in place within the firm to ensure that the validation cycle operates properly and efficiently. It looks at issues of people, governance and operations and presents case studies and working examples to share good practice across the market.

I would like to thank the members of the IMIF workstream who produced this work and particularly Matthew Pearlman from LCP and Karun Deep and David Innes from RSA for their work researching and developing the approach in this booklet. The members of our IMIF Steering Committee also provided overall project guidance and quality control. We are also grateful to representatives from the Bank of England (PRA) who have enabled us to maintain a continuous and positive dialogue between industry and the regulator on the work of the IMIF.

I would also like to thank our sponsors Milliman, PwC, EY, Deloitte and KPMG. Also, thanks are due to the Institute and Faculty of Actuaries and to ORIC International and other IRM practitioners for their input to this project. As a not-for-profit organisation IRM is reliant on enlightened industry support to help us publish documents like this. It is this kind of support that helps us maximise our investment in the development and delivery of world class risk management education and professional development.

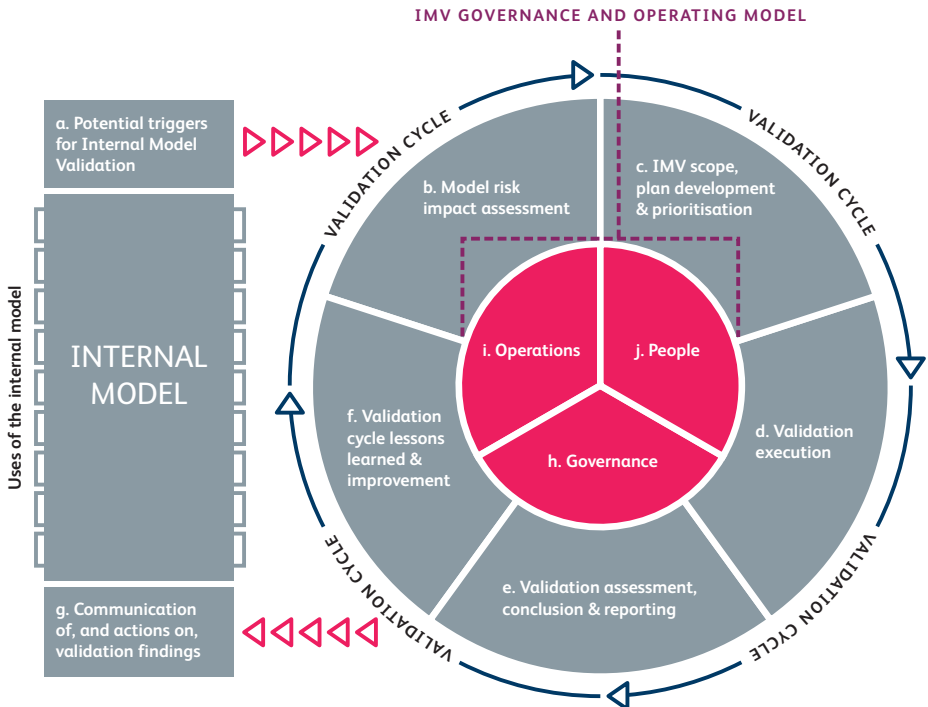
**José Morago,**  
**IRM Chairman and Founder of the**  
**Internal Model Industry Forum (IMIF)**

# Introduction

Validation is a key tool to help the Board understand the strengths and weaknesses of the model, and provide an independent view on the outputs, key limitations and overall appropriateness for use.

This booklet addresses the governance and operation of the internal model validation in principle, focussing on the systems, processes and controls that the firm needs to put in place to enable efficient and effective completion of the validation cycle. Insurance firms surveyed by IMIF (across a range of sizes and sectors) largely reported feeling well prepared for this aspect of the validation of their Solvency II model. However, there are continuing challenges in ensuring a cost-effective and value-adding model validation programme.

For more information on the validation cycle, as depicted in this diagram, see our previous IMIF publication “The validation cycle: developing sustainable confidence and value”.



## Emerging discipline in a moving regulatory environment

Solvency II requires firms to establish validation processes to ensure that the internal model (IM) is appropriately designed, tested, documented, implemented and used. The Solvency II directive requires a regular cycle of validation (Article 124) that includes:

- model performance, its on-going appropriateness, and testing its results against experience;
- an effective statistical process for validation of the IM (to ensure resulting capital requirements are appropriate);
- analysis of stability and sensitivity to changes in underlying assumptions; and
- assessment of accuracy, completeness and appropriateness of data.

The PRA has stated that it views model validation as a framework for providing efficient challenge for the Board to ensure the model is appropriate on an on-going basis. It provides an independent view on the outputs, key limitations and overall appropriateness for use.

## Model assurance

The validation framework needs appropriate focus both:

- “Bottom-up” – looking at individual assumptions, inputs and risks
- “Top-down” – a holistic review to enable focus on key areas

Put another way, it must address the two key questions

- Does the model do what we want it to do?
- Have we got the right model (is it fit for purpose)?

Validation teams are improving their ability to provide a top-down view, as they mature in role, and organisational understanding of capital models increases.

As firms progress beyond internal model approval, the role of the independent validation team is evolving and becoming critical to maintaining firms’ compliance with requirements of the Solvency II directive as well as other regulatory requirements, and in ensuring the Board maintains confidence in the appropriateness of its economic capital model.

The overall model assurance framework relies on the quality of justification of internal model inputs and outputs by the business and validation of the model by an independent internal and/or external team. Aspects of a sustainable operating model for validation, with case studies and suggested working examples, are presented in this booklet to give a guide to businesses in setting up their validation function.

# People

## Responsibility for validation

Responsibility for ensuring the model is properly validated lies ultimately with the board. However, they will do this with support from the rest of the team.

An insurer must ensure it has the right resources. Some points to consider are:

- **Skills and experience:** Whilst capital actuaries would be a logical fit for validation roles, they are by no means the only individuals who can contribute to the process. An understanding of capital and risk in an insurance business is a pre-requisite along with a strong mathematical background, but accountants, actuaries, auditors and broader financial professionals can all play a major role in these activities. Strong challenge greatly benefits from experience – it lends credibility, allows a sense of perspective and the ability to prioritise and can help validation teams deal with tricky situations to find solutions.
- **Independence is key.** There are various ways to structure this across 1st, 2nd and 3rd lines of defence. What is important is ensuring an environment where the model can be independently challenged and findings can be escalated and acted upon.
- Reporting lines that allow appropriate challenge and escalation.

It is critical that those responsible for validating the model are independent from the model build. This is to ensure that there is no bias in the assessment of the build and parameterisation of the model, and that those judging it are sufficiently removed so that if an aspect of the model is not clearly communicated they are able to identify this. Validation reporting should demonstrate the independence between people involved in the build and the validation of the model.

*“Strong challenge greatly benefits from experience – it lends credibility, allows a sense of perspective and the ability to prioritise and can help validation teams deal with tricky situations to find solutions.”*

## Internal and external resourcing

Validators could be internal or external to the company, or a combination of both. Either way, the responsibility still ultimately rests with the board.

If the validators are **internal** to the company, they may be from a different team within the actuarial department, such as the reserving team, or another department within the company, such as risk. Actuarial teams are generally more suited to a technical review, for example checking whether the model is calculating correctly and the parameterisation is reasonable. The risk department will have a greater perspective of the risk setting within the business as a whole, and would therefore be useful for reasonableness checks.

**External** validators can be useful for smaller companies where teams work closely together and there is not as much distance between those building the model and other departments. In this case, external validators can perform the full validation of the model and write up the report. In larger companies, external validators can bring new ways of looking at issues, and can provide expertise for deep dives into specific areas of investigation. In any case, the person managing the relationship with the consultants should still be independent of model build, to avoid any conflict of interest. Furthermore, external validators can help assess the robustness of the skills within the team.

A **combined approach** may involve, for example, validation being performed internally and then reviewed by external consultants. This can be a cost-effective way of ensuring independence and a thorough validation in compliance with regulatory requirements.

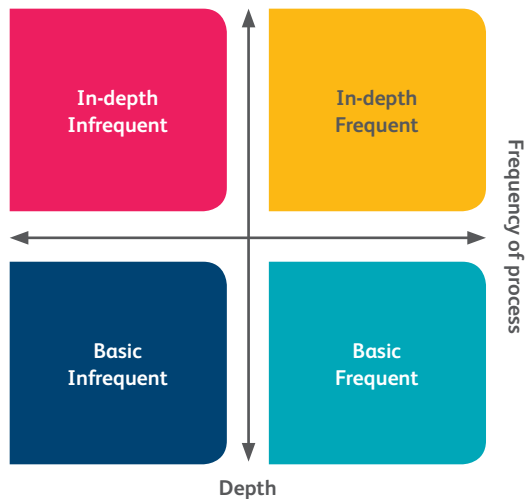
# Operations

## Validation approach and processes

There is not a single one-size fits all approach that can be applied to all areas that require validating. A good process should include a variety of approaches to best meet the validation requirements and the needs of the business.

The annual process will depend on the organisation and its risk profile. The depth and frequency of review for each process should be set in advance as part of the validation framework. This should then be revisited periodically taking account of feedback from the previous validation cycles. One way of looking at this is shown in the diagram below.

Once the frequency and depth of validation for each area have been agreed, the process can be set up accordingly ranging from “In-depth frequent”, which requires a tight defined process and many automated steps, to “Basic infrequent”, which might be applied outside the main validation team. The features of each quadrant of the graph are detailed in Appendix A.





## The tools of validation

The validation framework should specify the tools that will be used to test each area of the model, for example scenario testing, risk ranking and benchmarking. Each tool performs a specific role, whether it is to test the general functioning of the model, or to analyse the response of the outputs to extreme scenarios. They should be selected for their suitability for the relevant area of the model, and used in combination to provide a holistic approach to model validation.

Appendix B sets out the main tools and what they are used for.

## Validation infrastructure

A validation programme needs certain infrastructure and IT system capability. This needs careful planning, including considering the level of future-proofing that fits in with the risk tolerance of the organisation. A variety of tools can be used including:

- Modelling platforms such as IGLOO or Remetrica (can consider read only access for validators)
- Risk databases so observations can be reported and escalated
- Market data tools such as Bloomberg and Reuters
- Shared documentation servers for global teams

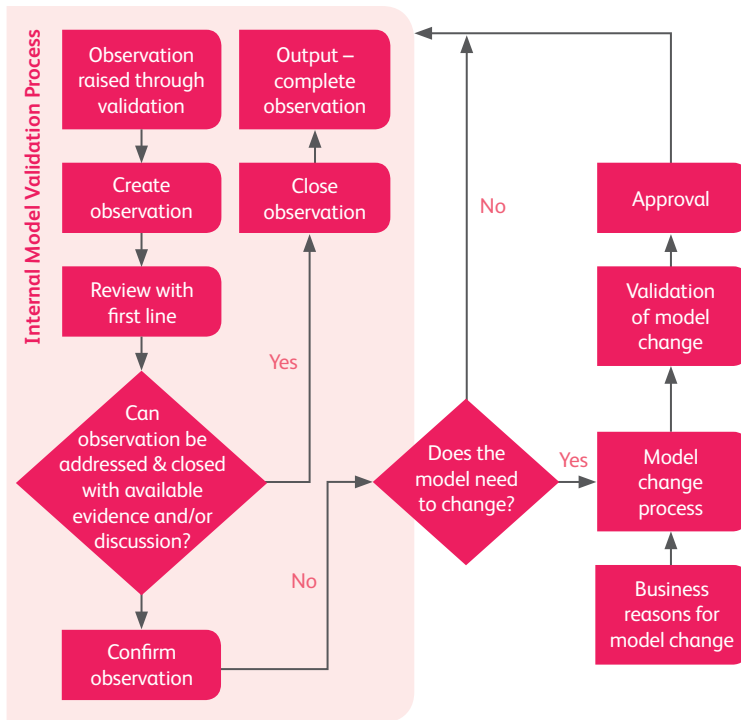
*“A validation programme needs certain infrastructure and IT system capability. This needs careful planning, including considering the level of future-proofing that fits in with the risk tolerance of the organisation.”*

## Approach to model change

Validation can flag the need for model change, which may then require further validation. This then becomes part of an ongoing cycle of model improvement.

The validation process can also be used to inform appropriate indicators for classifying model changes as major or minor.

This means the validation process should become a continuous cycle of improvement.



Model governance committees have responsibility for overseeing model changes and ensuring they receive appropriate governance.

This includes having a clear model change policy, with classification into ‘major’ and ‘minor’ changes. There are various views on how to classify such changes including:

- Quantitative metrics linked to outputs, eg. amount or percentage of capital
- Qualitative metrics allowing more judgement but which are more subjective

The governance must also establish an appropriate materiality assessment, which will affect validation expectations. These are influenced by:

- The level of assurance required internally by committees/boards
- Regulatory expectations
- Whether assurance is required before approval of changes or as part of cycle

## Annual timetable

Below is an example annual timetable, showing the considerations made as part of model validation, and their place in an iterative cycle of use and development.

Note that the actual timetable will vary significantly between companies. For example, some companies work to a quarterly, rather than annual, cycle.

January February March	Build/parameterisation – with concurrent reasonableness checks and identification of any issues	Potential triggers and impact assessment of those triggers to determine what type and degree of validation is necessary for the upcoming year
April	Internal model validation scope, plan development and prioritisation	
May June July	Validation testing	
August September	Assessment, conclusions and reporting	Reporting to board or external regulators
October November December	Validation process – lessons learned and improvements	Communication of, and actions on, validation findings for future model change and development

# Governance

## Board engagement

Board engagement is a key part of the governance of internal model validation, with insurers required to demonstrate that the implications of the validation process are understood and prioritised by the Board.

The PRA views model validation as a framework providing efficient challenge for the Board to ensure the model is appropriate on an ongoing basis. We see the following as key aspects to the role of internal model validation:

- independent series of reviews to provide the Board with information on the key strengths/weaknesses, limitations and appropriateness of the model;
- ahead of model approval, provides the Board with information regarding areas of concern and regulators with assurance that internal controls are appropriate and model changes governed;
- post model approval, provides the Board with assurance on the ongoing appropriateness of the model and to feed into a continuous cycle of model improvement; and
- ensures the model is appropriate for use in a number of areas as the process matures.

Model validation is now a recognised industry practice and is emerging as a formal discipline for risk and actuarial professionals.

Validation should be viewed alongside other key materials presented to the Board, external validation as well as industry information such as SRI benchmarking. The Board should be involved in the early planning and prioritisation stages to ensure that the final product meets its expectations.

## Validation report

A validation report is likely to be the main output that senior management and the Board see when reviewing the validation work performed by the business.

It is important that the report is structured in a way that clearly highlights the key conclusions arising from the validation performed and the remedial actions (if any). It must also meet regulatory requirements from the PRA and (if applicable), Lloyd's. These include a demonstration of the independence of the validator from the build process.

It is important for the report to make clear the uses for which the model has been validated. If the business wishes to use the model for a different purpose, then further validation may be required.

Some companies will have separate full and summary validation reports for different readers. A possible structure of a full validation report is in Appendix C.

## Key elements of board communication

To ensure the appropriate level of engagement at Board level of the internal model validation process, results must be communicated clearly and efficiently.

### Clearly stated validation objective, scope, framework

- Demonstrate that all elements of validation are covered and where they need to look for it.
- Demonstrate all regulatory requirements are met.
- Provide assurance regarding the independence of the validation activity.

### Use test questions

- The Board should have a clear understanding of where the model is used, which use is intended, and whether it is fit for those purposes.
- Smart use of graphics can be more effective than text, tables and numbers.

### Standardised validation test questions

- Understandable, standardised tests with digestible results that make it easy to understand the purpose of the test and key findings.

### Regular reporting and/or agenda item

- Ensure that validation is a regular agenda item on model governance /risk committees.
- A single annual report can ensure that all relevant information is available in one place, and can feed into a planned cycle of risk reporting.

### Single internal model validation report

- Currently a requirement for Lloyd's.
- Ensures that the Board is reviewing all information in one place. Includes clear confirmation statements specific to the business providing the Board with the level of assurance it needs.

## What does good governance look like?

It is key that the governance process leverages the maximum benefit from the validation approaches adopted. The following are some main indicators as to whether the governance process in place is appropriate.

Area	Good practice	Negative indicators
Decision making	Governance processes ensure senior decision makers and the Board can accept that validation aids understanding and trust of the model outputs, assumptions, key drivers, representation of the firm's risk profile, performance and its limitations.	Validation purpose appears only as a regulatory tick box exercise, considered as an unwelcome and costly (but necessary) overhead.
Use of model	Perceived value of the internal model is enhanced through: <ul style="list-style-type: none"> <li>• Extensive use in business decision making</li> <li>• New uses and model improvements being actively sought by business decision makers as well as technical experts</li> <li>• Benefits being seen to outweigh the costs of validation</li> </ul>	Limited senior visibility or understanding of validation purpose or results.
Policy	Governance processes ensure a suitable validation policy is adopted, kept up to date and adhered to with clear roles and responsibilities, ensuring appropriate independence and that unimpeded escalations are made when appropriate.	Validation discussions are dominated by process and cost over content, business implications and actions.
Challenge	Validation observations and recommendations are openly discussed in terms of their non-technical business implications and involve relevant people outside Actuarial/Risk.	Challenge appears to be predominantly in the low level technical detail rather than key judgment areas of assumptions, tools and testing.

Area	Good practice	Negative indicators
<b>Independence</b>	<p>Ensures demonstrable independent challenge in validation over:</p> <ul style="list-style-type: none"> <li>• Scope</li> <li>• Tools used</li> <li>• Range of expert judgements considered, proportionate to materiality with assessments of the pros and cons of each</li> <li>• Reporting, including rating of model performance and limitations, to assess degree of representation of firm's risk profile</li> <li>• Effectiveness and timeliness of actions taken</li> <li>• Model improvement plans are followed up on regularly</li> </ul>	<p>Validation appears insufficiently independent; few significant recommendations are made or adopted.</p>
<b>Proxy models</b>	<p>Any proxy models used are demonstrably validated alongside the full model to ensure confidence in their continuous use and limitations.</p>	<p>Any proxy models used to make business decisions are not regularly demonstrably validated against the full model.</p>
<b>Compliance</b>	<p>In doing the above compliance is demonstrated with the regulatory spirit and letter (SII – Art 124, PRA requirements).</p>	<p>Compliance with regulatory requirements cannot be demonstrated.</p>
<b>Integration</b>	<p>Ensures regular checks and governance by first line can be reviewed and incorporated into the validation cycle alongside selected ad-hoc reviews.</p>	<p>Validation is fragmented and not suitably interactive with other business processes.</p>

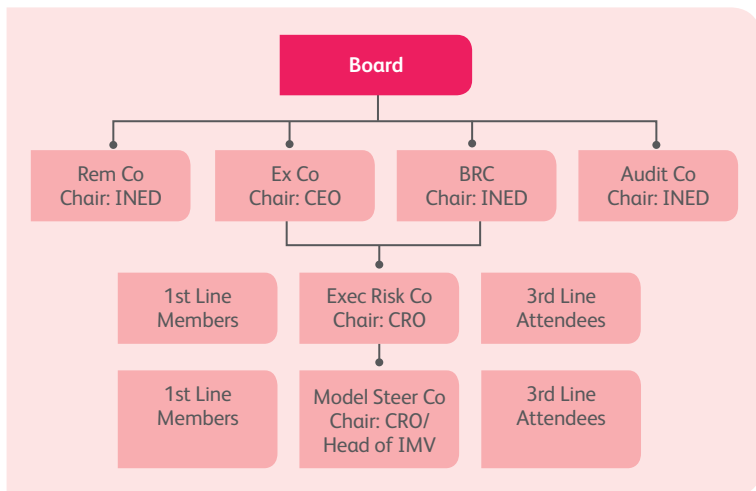
## Conclusion

As noted, the industry still has some way to go in order to achieve a cost effective and sustainable operating model for validation activities, enabling strong communication with the Board and key stakeholders. This booklet has presented examples of best practice, which will undoubtedly evolve once the Solvency II regime goes live.

# Case studies

The first case study shows the structure of one firm and why it works well. The second case study shows how a reorganisation of the governance model enhanced the value from the validation process.

## Case study 1: Example internal model validation governance structure



- The structure proves effective in encouraging healthy discussion through having multiple viewpoints represented at the committees: 1st, 2nd and 3rd lines of defence, at both practical and technical levels
- Clarity of roles of each committee is key – the Board Risk Committee (BRC), Executive Risk Committee (ERC) and Model SteerCo have distinct and complementary terms of reference. This enables them to set clear roles and expectations for the 1st line (capital modelling) and 2nd line (validation) teams.



- Having the CRO as Chair of the Model SteerCo demonstrates independence of modelling development activity undertaken by the 1st line. This ensures that validation findings are given due attention
- The reporting line through to BRC demonstrates a flow of 2nd line challenge to the Board
- The structure is effective because the range of individuals' experience is brought to bear in an environment where openness and constructive challenge are encouraged, and the committees meet with sufficient frequency to maintain an appropriate degree of momentum
- 3rd line representation is useful because it provides a good perspective on aspects and culture of the internal control environment
- To encourage greater use of the Internal Model as it matures, committee membership could be expanded to include representatives from Capital Management, Financial Reporting and Financial Control

The biggest challenges from this structure have been:

- Maintaining sufficient independence between Validation and Model SteerCo.
- Taking decisions by committee can challenge individual accountability
- Some of the committees can become large, and it is been important to ensure that those charged with making decisions remain sufficiently engaged
- The layers of governance can sometimes appear bureaucratic and require secretarial support to remain robust. The structure may, therefore, not be appropriate for smaller organisations

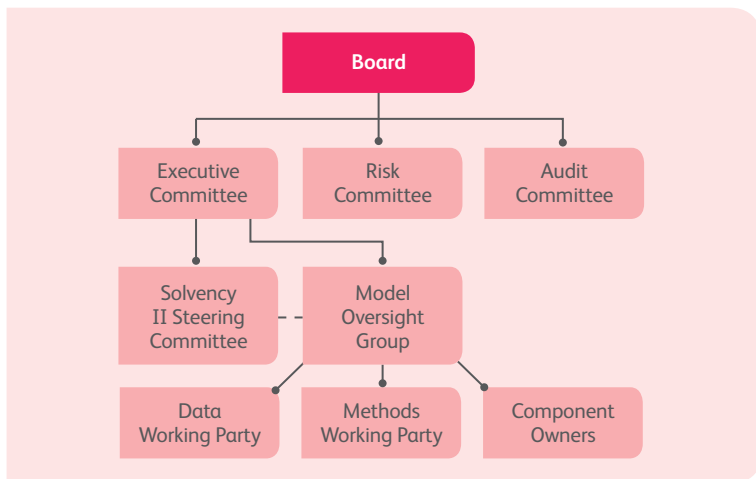
## Case study 2: Leveraging the governance process

### Background

The company uses an entirely internal validation. The first line comprises the component owners of the model. The second line is the risk function. The third line is internal audit.

Questions were raised over the independence of the validation process. The company was challenged to demonstrate how independence was maintained.

Challenge was raised in particular because in its intention to create the best validation tests possible and to demonstrate that all aspects of the model were being fully validated, the component owners had been given free licence to create as many validation tests in whatever form as they saw fit. Although reviewers of the process remarked on the high quality of these tests, they raised concern that the process did not contain sufficient built-in protection against abuse.



## Resolution

The key to the resolution was the extended use of the Model Oversight Group (“MOG”). The MOG had taken an important steering and oversight role in the model development and its role was already formalised into the model change and escalation procedures. Its role within validation had hitherto been to review and sign off on the results.

The validation process was rewritten so that the MOG was now the arbiter regarding test design for each and every first line validation test. In order to set this process in motion, two immediate steps were required:

### 1. The restructuring of the MOG itself.

- Originally set up as a development steering group, the MOG contained a number of component owners as members of the group.
- If the MOG was to be able to independently authorise the use of validation tests, this would need to change.
- As such, component owners became standing invitees of the MOG, whilst new, fully independent experts were found to be full members.

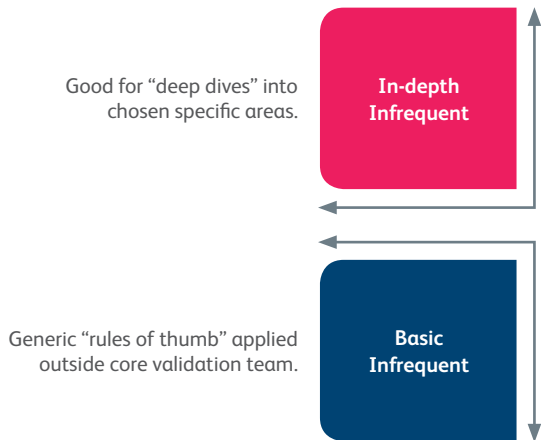
### 2. Every existing validation test had to be reviewed by the MOG for authorisation prior to use in the next validation cycle.

- First, the MOG had to come up with a basis for judging the suitability of tests (including agreeing a universal basis for the assessment of materiality).
- Then component owners were tasked with presenting their existing suite of tests to the MOG.
- Challenges were captured into remediation logs and revised tests re-presented until such a time that the MOG were fully satisfied.

The review of every validation test was a substantial undertaking. MOG meetings were held at least two or three times a week (and frequently on a daily basis) over the course of six weeks. Once completed, however, the MOG had comfort that the final suite of tests formed a comprehensive and robust first line validation of the internal model, and that this could be evidenced both in terms of process and result.

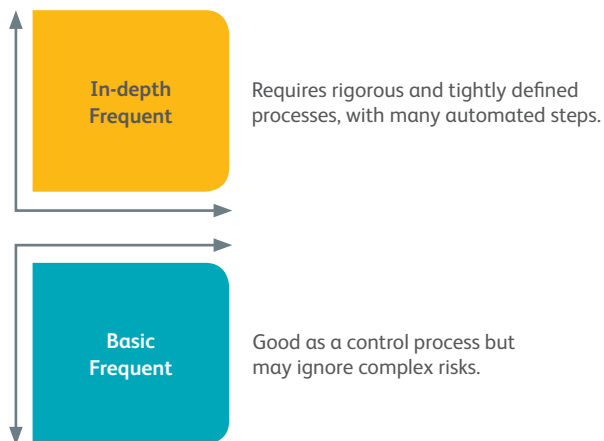
# Appendix A – Validation approach

<b>What is it?</b>	A “deep dive” into specific areas of focus
<b>When is it used?</b>	As part of the annual validation cycle. Specific areas of focus for each validation cycle should be identified in advance.
<b>Pros</b>	A knowledgeable “outsider view” of the risks inherent to each area of focus is key, which gives an independent view of the model.
<b>Cons</b>	The range of “in-depth” analysis would be relatively narrow and so it is important to vary the focus each year.
<b>Examples</b>	One-off review of market risk and ESG, possibly using external expertise. In depth review of output correlations between risk classes, classes of business, geographies etc.



<b>What is it?</b>	Overall high level view of model.
<b>When is it used?</b>	For informal validation by all users and component owners of the model.
<b>Pros</b>	Encourages those closer to the model to develop “rules of thumb” to test model inputs and outputs. Encourages an active feedback process that benefits from many pairs of eyes.
<b>Cons</b>	Can bypass true understanding of the workings of the model.
<b>Examples</b>	Ad hoc tests by business users of the model to satisfy themselves that the output is reasonable.

<b>What is it?</b>	<b>Regular validation of aspects of the model as they are altered or added.</b>
<b>When is it used?</b>	For model changes and development. Automated first-line tests with clear pass/fail criteria. Tightly defined and replicable second-line tests showing complete coverage of tests and standards.
<b>Pros</b>	Users of the model can be confident of the outputs as the model is being developed, not just when required by the regulators.
<b>Cons</b>	Breadth of testing required needs to be considered carefully – automated processes may deliver good coverage, but may need to limit the number of subjective tests for efficiency.
<b>Examples</b>	Scenario testing to test whether the model captures a sufficient risk range. Reconciliations of balance sheet items.



<b>What is it?</b>	<b>Simple testing with clearly defined pass/fail criteria that can be easily automated.</b>
<b>When is it used?</b>	For tests that are not expected to regularly fail. Any fail will need strong justification.
<b>Pros</b>	Easily automated and reapplied to every model run.
<b>Cons</b>	More complex problems or changes in the makeup of business over time are unlikely to be picked up this way.
<b>Examples</b>	Line by line checks of the model outputs versus inputs. Use of externally recognised lenses such as Standardised Risk Information data (collected by the PRA) to compare year on year movements.

# Appendix B – The tools of validation

The validation framework should specify the tools that will be used to test each area of the model. The methods described here are a selection of approaches that are commonly used.

Each performs a specific role, whether it is to test the general functioning of the model, or to analyse the response of the outputs to extreme scenarios. They should be selected for their suitability for the relevant area of the model, and used in combination to provide a holistic approach to model validation. The following are examples and this is not an exhaustive list.

Validation tool	What is it used for?
<p><b>Scenario and stress testing</b></p> <p>Scenario testing looks at the impact on the business of potential extreme and hypothetical scenarios focussing on whether the implied return period for that scenario is realistic.</p> <p>Stress testing is similar to sensitivity testing, but parameters are changed in a more extreme (though still plausible) way.</p>	<p>These are key tests across underwriting and reserve risk, and could be used across all areas, as they are fairly straightforward tests to implement. They are particularly useful for analysing how the model behaviour ties in with expert judgement.</p>
<p><b>Reasonableness checks</b></p> <p>Reasonableness checks independently verify that the results (or intermediate results) are in line with expectations, given the model inputs.</p>	<p>Reasonableness checks are a good choice to test all areas of the model. Their strength is in the independence of having separate calculations. A simplified model could be produced in a spread sheet, which breaks down the calculation into parts that are easier to analyse than the full model.</p>
<p><b>Risk ranking</b></p> <p>This is the process of ranking the relative significance of model outputs – for example ranking the contribution to reserve risk from each line of business.</p>	<p>A useful tool when there are many lines of business to help identify the areas of the model requiring the most extensive validation. It also enables a high level check of the model to see if the ranking is in line with internal views.</p>
<p><b>Benchmarking</b></p> <p>Benchmarking involves comparing the results of the model to alternative data sources and market peer groups for reasonableness.</p>	<p>This can be a powerful and reassuring tool. However, businesses are different and benchmarking might imply that there is an issue but an outlying result may be entirely appropriate for the business.</p>
<p><b>Reverse stress testing</b></p> <p>This tool involves identifying the scenarios and events which could lead to an insurer's insolvency. Insurers must not only consider the capital losses that would make them insolvent, but any loss of trust from the markets which would make their business plan unviable.</p>	<p>This is being given increasing emphasis by the PRA. The exercise should encourage better business planning and understanding of the most material risks throughout the business. In turn, this allows firms to take steps to mitigate these risks. It also serves the purpose of ensuring that the model output adequately represents the risks facing the firm.</p>

Validation tool	What is it used for?
<p><b>Back-testing</b></p> <p>This compares the model calculations with known historical experience. The purpose is to test the correspondence between forecasts made by the model and actual historical realisations. If historical data is limited, this can be supplemented with hypothetical loss data.</p>	<p>Over time, back-testing will help assess the extent to which the model predictions compare to the actual outcomes.</p> <p>Back-testing is most appropriate for Reserve and Underwriting risk.</p>
<p><b>Goodness of fit testing</b></p> <p>As with back-testing, this compares model calculations to known experience, but the aim is to determine whether the statistical distributions used are appropriate.</p>	<p>This approach may be chosen to assess the appropriateness of the underlying parameterisation for Underwriting Risk, for example.</p>
<p><b>Validation of external models eg ESG and CAT models</b></p> <p>Some internal models use external models to cover specialist areas. These would need to be validated depending on the source.</p>	<p>An internally built ESG would be validated as part of the build. An externally purchased one would be validated by the provider although some high level reasonableness checks for the specific business would be sensible.</p>
<p><b>Sensitivity testing</b></p> <p>Sensitivity tests consider movements in the outputs of the model in response to changes in the assumptions and parameters used by the model.</p> <p>These changes can either be:</p> <p>Type 1 – an arbitrary percentage change to an assumption; or</p> <p>Type 2 – a plausible alternative selection to the base assumption.</p>	<p>Sensitivity testing is a useful tool across all risk areas. It is used to confirm that the model is working as expected, by testing whether the direction or magnitude of any movement is in line with expectation.</p> <p>Examples of sensitivities would be:</p> <ul style="list-style-type: none"> <li>• increases in the standard deviation of Attritional losses (Underwriting Risk)</li> <li>• increase in the assumed probability of default for reinsurers (Credit risk)</li> <li>• increase in the assumed correlation across major risk areas (Aggregation and correlation).</li> </ul>
<p><b>Simulation/Convergence Testing</b></p> <p>This assesses the number of trials required to obtain stable results. This is achieved by varying the seed or the number of trials and assessing the impact on the modelled capital figure.</p>	<p>This is a good overall test for the build of the model. It ensures an appropriate number of trials are being run in the model that leads to a reliable and stable set of results.</p>

Validation tool	What is it used for?
<p><b>Standard formula SCR comparison</b> This test reconciles the results of each standard formula risk module with the equivalent internal model output.</p>	<p>The aim is to understand and explain the differences arising between the results of the standard formula and the internal model. It can be of limited value if the standard formula is not representative of the risk profile of the business.</p>
<p><b>Analysis of model outputs</b> Including simulation analyses, correlations, SRI data.</p>	<p>A test to confirm the general functioning of the model.</p>
<p><b>Profit and loss attribution</b> This test aims to confirm that the sources of profit and loss in recent experience are captured by the model, and to verify that it is able to simulate scenarios that are broadly consistent with this experience.</p>	<p>This is a form of back-testing, comparing actual profit and loss results against model risk categories, as well as demonstrating that the outcomes in respect of individual risks are within an expected range.</p> <p>Profit and loss attribution would typically be carried out for each major class of business, on a gross and net of reinsurance basis.</p>
<p><b>Qualitative testing</b> This involves the assessment of the appropriateness, strengths and weaknesses of the parts of the internal model through methodology reviews, process reviews and/or documentation reviews.</p>	<p>These tests are typically used to assess expert judgements and decisions relating to model design and implementation. They can often be used to supplement quantitative testing or in cases where it is not possible and/or appropriate to undertake quantitative testing.</p>



# Appendix C – Validation report

A possible structure of a full validation report is shown below:

## **Executive summary**

- Confirmation statements (Lloyd's requirement)
  - Explicit confirmation that the objectives of the validation process have been met.
- Key findings
- Summary of validation process
- Key remedial actions for the future

## **Purpose and scope**

- Scope of the validation process
- Governance process
- Assessment of independence
- Skills of validator
- Changes since last report

## **Validation results**

- Summary of high-level findings
- Qualitative and quantitative testing of each area of the model summarising for each key test:
  - approach taken;
  - results and key findings; and
  - improvements identified for next validation cycle
- Data, systems and IT
- Documentation
- Model governance and use
- Expert judgement
- Limitations

## **Approach, methodology and limitations**

### **Appendices**

- Validation testing schedules
- References to other key relevant internal documentation  
e.g. Model Validation and Change policy

## Our project team

We would like to thank the following people and their employers for their work on this document:

### Workstream leader:

**Karun Deep**, Risk Manager, RSA

**David Innes**, Group Capital and Financial Risks Director, RSA

### Consultancy support:

**Matthew Pearlman**, Partner, Lane Clark & Peacock LLP

### Workstream members:

**Patrick Nolan**, ACE Group

**Michael Bartholomeusz**, Flood Re

**Nicolaos Panayiotou**, Lloyd's

**Alex Hindson**, Argo

**David Richardson**, Parker Fitzgerald

## Our steering committee

The IMIF steering committee comprises:

**José Morago**, Aviva (Chair)

**Tamsin Abbey**, Deloitte

**Roger Jackson**, KPMG

**Raphael Borrel**, Vitality

**Tony Jeffery**, Bank of England (PRA)

**Simon Cartlidge**, L&G

**Rob Merry**, HSBC

**Alastair Clarkson**, Standard Life

**David Paul**, E&Y

**Robert Collinson**, Towers Watson

**Matthew Pearlman**, LCP

**Caroline Coombe**, ORIC International

**Niraj Shah**, Ageas

**Karun Deep**, RSA

**Michael Sicsic**, ORIC International

**Sebastien Delfaud**, Bank of England (PRA)

**Justin Skinner**, QBE

**Vishal Desai**, Bank of England (PRA)

**Barney Wanstall**, PwC

**Steven Graham**, Institute and Faculty of Actuaries

**Russell Ward**, Milliman

**David Innes**, RSA

**Carolyn Williams**, IRM

# The Internal Model Industry Forum

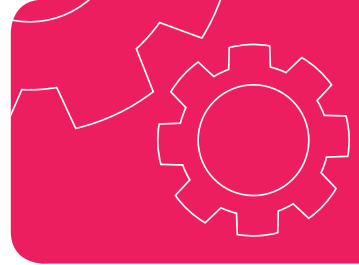
This document has been produced by the Internal Model Industry Forum (IMIF). The Institute of Risk Management (IRM) set up the IMIF in 2015 to address the key questions and challenges that insurers face in the use, understanding and validation of internal risk models. It is designed to work in a collaborative way to develop and share good practice to ensure that these models add value to the organisation and support regulatory compliance. IMIF now has over 300 members and we have run a series of Forum meetings to explore key issues. A number of workstreams are also undertaking research and we aim to publish the results along with other useful resources and guidance.

As the leading organisation promoting education and professional development in all aspects of risk management, IRM is pleased to be able to support this industry initiative to share good practice.

**More information about the IMIF and its work can be found on the IRM website [www.theirm.org](http://www.theirm.org)**

## Who are the IRM?

This work has been supported by members of IRM, which has provided leadership and guidance to the emerging risk management profession for over 25 years. Through its training, qualifications and thought leadership work, which includes seminars, special interest and regional groups, IRM combines sound academic work with the practical experience of its members working across diverse organisations worldwide. IRM would like to thank everyone involved in the IMIF project.



## IRM

T: +44(0) 20 7709 9808

E: [enquiries@theirm.org](mailto:enquiries@theirm.org)

[www.theirm.org](http://www.theirm.org)

### Institute of Risk Management

2nd Floor, Sackville House  
143-149 Fenchurch Street  
London  
EC3M 6BN  
United Kingdom

## Our supporters

As a not-for-profit organisation, IRM is reliant on industry support to publish guidance like this. We would like particularly to thank the following organisations who have made this publication possible:



**pwc**

PricewaterhouseCoopers LLP

### Barney Wanstall

[barney.wanstall@uk.pwc.com](mailto:barney.wanstall@uk.pwc.com)

### Bill Gasson

[bill.gasson@uk.pwc.com](mailto:bill.gasson@uk.pwc.com)  
[www.pwc.co.uk/](http://www.pwc.co.uk/)

 **Milliman**

### Russell Ward

[russell.ward@milliman.com](mailto:russell.ward@milliman.com)  
[uk.milliman.com/](http://uk.milliman.com/)

**Deloitte.**

### Tamsin Abbey

[tabbey@deloitte.co.uk](mailto:tabbey@deloitte.co.uk)  
[www2.deloitte.com/uk/en.html](http://www2.deloitte.com/uk/en.html)

 **KPMG**  
*cutting through complexity*

### Roger Jackson

[roger.jackson@kpmg.co.uk](mailto:roger.jackson@kpmg.co.uk)  
[www.kpmg.com/](http://www.kpmg.com/)



**EY**

Building a better  
working world

### Michael van Vuuren

[mvanvuuren@uk.ey.com](mailto:mvanvuuren@uk.ey.com)  
[www.ey.com](http://www.ey.com)