



BERMUDA MONETARY AUTHORITY

CONSULTATION PAPER

STANDARDS AND APPLICATION FRAMEWORK FOR THE USE OF INTERNAL CAPITAL MODELS FOR REGULATORY CAPITAL PURPOSES

30th April, 2009

Table of Contents

Purpose and Executive Summary	3
Background.....	4
Framework for Application and Review Process	7
Pre-Application Conditions	7
Application and Review Process	7
Post-Approval Monitoring and Control Process.....	10
Attachment A: Self-Assessment Process	11
Introduction.....	11
Affirmation Statements.....	12
Guidance for Affirmation Statements.....	15
Use Test	15
Statistical Test.....	17
Calibration Test.....	18
Validation.....	19
Documentation.....	20
Model Governance.....	21
Internal Controls	23
Risk Categories	24

Purpose and Executive Summary

1. This consultation paper provides guidance on the Bermuda Monetary Authority's ("the Authority") proposed standards and application framework for Class 4 insurers¹ applying to use an Internal Capital Model ("ICM") for regulatory capital purposes.
2. The main body of the paper establishes the proposed framework for the application and review process and includes provisions relating to pre-application conditions, application and review procedures, and post-approval monitoring and control activities.
3. Attachment A provides guidance on the self-assessment process, which is the first stage of the application and review process. The self-assessment process requires an insurer to affirm that its ICM meets a number of general standards prior to the commencement of an ICM review.
4. The views of the insurance industry and other interested persons on this draft framework are invited. Comments are welcome on all matters covered in this paper, including the following:
 - overall structure and timeline of the application and review process;
 - whether the proposed approach is consistent with international regulatory and industry best practices for economic capital models;
 - proposed self-assessment process;
 - guidance provided for affirmation statements and issues that may require further elaboration or impose prohibitive costs relative to their benefits;
 - minimum standards in areas not mentioned that need to be developed;
 - proposed risk categories; and
 - initial views regarding the nature of information requests for the ICM application and review process and interest in participating in the consultation process during the development of these requests.
5. Comments should be sent to the Authority's Actuarial Services Department via e-mail to Brant Kizer at bkizer@bma.bm not later than May 31, 2009. The Authority intends to publish a final version of this document on its website (www.bma.bm) on or before June 30, 2009.

¹ In this guidance note, "insurer(s)" refers collectively to insurer(s) and reinsurer(s) unless otherwise specified.

Background

6. The International Association of Insurance Supervisors (“IAIS”) defines an ICM as:

“A risk management system developed by an insurer to analyse its overall risk position, to quantify risks and to determine the economic capital required to meet those risks.”²
7. In general, an economic capital model estimates the amount of capital needed to fund future obligations over a specified period of time at a given confidence level.
8. A standard regulatory capital model, by its very nature, can only represent a proxy to an insurer’s specific risk profile. Alternatively, an insurer’s own economic capital model, if subject to rigorous and prudent controls, may be used to more accurately reflect the risk profile of the firm.
9. The IAIS and regulatory agencies worldwide are focused on encouraging insurers to prudently employ internal capital modelling in the risk and capital management processes, and not just as a tool for the determination of regulatory capital.
10. On December 31, 2008, the Authority issued an Order³ under the *Insurance Act 1978* prescribing a standard risk-based capital formula, the Bermuda Solvency Capital Requirement (“BSCR”), for the determination of an insurer’s regulatory capital requirement⁴ (“RCR”). The Order also includes a provision allowing an insurer to apply to the Authority for approval to use an ICM in substitution for the BSCR to calculate its RCR.
11. The rationale for encouraging the use of an approved ICM is to produce a RCR that better reflects an insurer’s particular business profile, strategies, operations and risk management processes. This approach should result in more precise measurement and monitoring of solvency and capital adequacy and a more efficient use of capital in the industry, provided it’s subject to appropriate prudential controls. This is particularly important in the Bermuda insurance market due to the concentration of large property catastrophe reinsurers and high-attaching commercial liability insurers, which require more sophisticated models due to the less predictable results and lack of homogeneity among insurers for these lines of business.

² IAIS *Guidance Paper on the Use of Internal Models for Regulatory Capital Purposes*, October 2008, Paragraph 5.

³ Insurance (Prudential Standards) (Class 4 Solvency Requirement) Order 2008.

⁴ The Order uses the term Enhanced Capital Requirement, which is defined in Section 1(1) of the *Insurance Act 1978*.

12. This guidance is intended to assist insurers in understanding the proposed application and review process and supplements Section 5 of the Order, which provides for the approval of an ICM subject to the following considerations:
- the appropriateness of the ICM for the determination of the insurer's RCR;
 - the extent to which the ICM has been integrated into the insurer's risk management programme; and
 - the appropriateness of controls applicable to the creation and maintenance of the insurer's ICM.
13. The standards and application framework established in this guidance have been developed with reference to the standards and guidance papers issued by other regulators, including the IAIS. As such, it is intended to be consistent with international regulatory practices.
14. In order to ensure that the framework is appropriately designed for application to the Bermuda market, the Authority has given due consideration to information received via an industry survey and related consultation with practitioners, which are summarised in the Authority's report on economic capital modelling.⁵
15. No model fully reflects the complexity inherent in real world processes. The Authority recognises that capital modelling is developing in theory and practice, and consequently, this guidance is not intended to be prescriptive. Each application will be considered on its own merits.
16. Each insurer's ICM will be unique by definition and will vary by complexity and scope. Certain drivers of risk may be modelled independently and at different levels of complexity in an insurer's ICM, and the Authority will take this into consideration during the ICM review process.
17. It is anticipated that some applications will include group ICMs and others will pertain to ICMs at a solo entity level. The Authority will work in cooperation with each insurer to evaluate its ICM at the appropriate entity level with the goal of avoiding duplicative effort.
18. The guidance provided in this paper relates only to the Authority's approval process for an ICM used to determine an insurer's regulatory capital requirement. As such, it does not apply to the use of an ICM for any other purpose.
19. As the state of capital modelling evolves, the Authority will consult with industry to refine the supervisory process and seek to update the ICM review standards appropriately while maintaining focus on the unique aspects of the Bermuda market. Anticipated revisions are likely to include expansion of the applicability of these

⁵ *Survey of Economic Capital Modelling Practices in the Bermuda Insurance Market*, Bermuda Monetary Authority, December 2008.

guidelines to classes of insurers beyond that of Class 4.

20. The Authority is also developing an Own Risk and Solvency Assessment (“ORSA”) regime, which will link closely to ICMs. An ORSA is an insurer’s own overall assessment of its capital needs, based on all of the current and prospective risks it faces, determined by reference to the entirety of its risk processes and procedures, and having regard to its business strategy and plan.⁶ The Authority will release a consultation paper regarding ORSA by September 30, 2009.

⁶ *Bermuda’s Insurance Solvency Framework: The Roadmap to Mutual Recognition*, Bermuda Monetary Authority, March 2009, p.7.

Framework for Application and Review Process

Pre-Application Conditions

21. An ICM will not be considered for approval unless the insurer can demonstrate a comprehensive and effective approach to risk management.
22. An insurer should also evidence a prudent approach to capital management, which includes the establishment and successful achievement of an internal capital target greater than the minimum RCR as indicated by the ICM.
23. Final versions of any documentation provided to the Authority as part of the ICM approval process should have the approval of the insurer's senior management and Board of Directors ("the Board").

Application and Review Process

24. The ICM application and review process comprises several stages, including, but not limited to, the following:
 - a self-assessment process, which provides an indication of the insurer's preparedness to undergo an ICM review;
 - an application for permission to use a specified ICM for the determination of the insurer's RCR;
 - the provision of quantitative and qualitative information as specified by the Authority;
 - the ICM review process, which will be conducted by the Authority on both an off-site and on-site basis with extensive dialogue and requests for supplementary information; and
 - the communication of results from the ICM review process with the insurer.

Self-Assessment Process

25. The Authority has developed a self-assessment process to provide guidance to insurers as to the criteria that should be satisfied prior to the commencement of an ICM review. The self-assessment is structured in the form of a number of qualitative and quantitative affirmation statements, which are attached in Attachment A. These affirmation statements are intended to reflect the general standards by which an insurer's application for the approval of its ICM will be considered.
26. The Authority will be available during the self-assessment process to provide guidance and to discuss any questions relating to the affirmations.

Application for ICM Approval

27. Once the self-assessment process is complete and the Authority provides confirmation, an insurer may then proceed with a formal application for the approval of its ICM. The application will include a completed initial information request and payment of the ICM application fee.
28. The application fee for the review of an insurer's ICM at the time of this paper's issuance is \$50,000. This fee is non-refundable, excludes other fees that may apply and may be revised from time to time.

Provision of Information

29. In order for the Authority to properly consider an ICM application, the insurer will need to provide complete and timely responses to all quantitative and qualitative information requests made by the Authority.
30. The information submission process will comprise several stages and include:
 - a standardised information request to be completed at the time of application;
 - a more specific request of information, which will take into account an insurer's unique attributes, to be completed soon after the application is submitted; and
 - supplemental requests to be completed from time to time during the course of the review process to further assist in the evaluation of an insurer's ICM.
31. Details relating to the information requests are currently being developed. The Authority has and will continue to seek market feedback relating to these requests but may do so outside the normal consultation process given the specialised nature of this area.

Review Process

32. The review process will involve both off-site and on-site examinations and discussions with various members of the insurer's staff.
33. In typical situations, the Authority's review process is expected to include the following elements:
 - review of responses to information requests;
 - review of any documentation related to the ICM; and
 - discussions with the insurer's management and staff.

34. For the sake of efficiency, the Authority will review and rely upon other regulatory assessments of an insurer's ICM to the extent practicable. The degree of reliance placed upon another regulator's assessment will be guided by the extent to which that regulator's approach is comparable to that of the Authority's, the sufficiency of documentation available, and any other factors that the Authority may consider appropriate.
35. Barring any extenuating circumstances, such as an incomplete or delayed application or information request, a large number of applications in relation to the Authority's available resources or any other unforeseen cause, the Authority will aim to render a formal decision regarding the acceptability of an insurer's ICM application within a six to nine month period following the receipt of the formal application for approval.
36. An insurer will be required to calculate its RCR using both its ICM and the BSCR formula for two reporting periods, with at least one reporting period occurring during the review process period.
37. Extensive consultation between the insurer and the Authority prior to submission of the formal application is encouraged. This along with accurate and thorough responses to information requests should expedite the review process.
38. Upon completion of their analysis, the ICM review team will present their recommendations to the Authority's Risk Committee for consideration. The Risk Committee will then decide whether or not to approve an insurer's ICM application.

Communication of Results

39. After the review process is complete, the Authority will send a formal response to the insurer regarding its application to use the proposed ICM for the determination of its RCR.
40. If the application is approved, the response will state the effective date and any conditions that may apply. The Authority may use the approach of 'conditional approval' and allow an insurer to commence using its ICM for regulatory capital purposes if there are areas that require further improvement or review but do not prohibit the approval of an insurer's ICM application. Conditions may include capital floors based on the BSCR, more conservative model parameters or design features or further review by the Authority, the insurer or a third party.
41. If the application is not approved initially, the Authority will outline any ICM deficiencies and take a collaborative approach with the insurer to resolve these deficiencies. If these issues cannot be resolved within a reasonable timeframe, then the Authority will not approve the ICM application.
42. In the event an ICM application is not approved, the insurer may make written representations to the Authority as provided for under Section 5 of the Order. If, after taking these representations into account, the Authority confirms its decision not to approve an insurer's ICM, the insurer may reapply once all ICM deficiencies have been resolved.

Post-Approval Monitoring and Control Process

43. Following approval of an insurer's ICM for regulatory purposes, the Authority will conduct scheduled periodic reviews to ensure that the ICM accurately assesses an insurer's risk exposures and associated capital requirements.
44. The insurer should advise the Authority of any material changes to the ICM resulting from amendments to the design, assumptions or insurer's risk profile. The threshold of materiality in relation to these modifications will be determined by the Authority in consultation with the insurer.
45. If any conditions of an insurer's ICM approval have been breached, the Authority will allow the insurer a reasonable period of time to cure such breach and work with the insurer in resolving any issues. If these outstanding issues cannot be cured within the allotted time, the Authority may revoke its approval of the insurer's ICM.
46. In the event an insurer's ICM approval has been revoked by the Authority, the affected insurer may make written representations as provided for under Section 5 of the Order. If, after taking these representations into account, the Authority confirms its decision to revoke the insurer's ICM approval, the insurer may reapply once all ICM deficiencies have been resolved.

Attachment A: Self-Assessment Process

Introduction

- A.1. The first stage of the ICM application and review process requires an insurer to perform a self-assessment of important quantitative and qualitative criteria. This entails completing the set of affirmation statements specified below. General guidance is provided for each statement, but this guidance is not intended to be exhaustive.
- A.2. The self-assessment should involve considerable internal review, and the final version of the affirmation statements will require the approval of the insurer's senior management prior to submission, including the Chief Executive Officer, Chief Financial Officer, Chief Risk Officer (or the person with responsibilities normally assumed by the Chief Risk Officer) and Board.
- A.3. An insurer is likely to have management information, procedures and documentation relating to the ICM in place already. The Authority will rely upon an insurer's established procedures to the extent practicable and seek to minimise documentation prepared solely for regulatory use.
- A.4. The affirmations consist of twenty statements within eight broad categories. An insurer's assessment should be objective and realistic, and management should carefully consider whether or not the insurer's ICM complies with the standards outlined before affirming each statement.
- A.5. It may take time for an insurer to confirm that all relevant ICM standards set out in this guidance are met. The Authority does not necessarily expect all standards to be met by an insurer's ICM at the start of the self-assessment or application process. The Authority will seek to develop a close dialogue with each insurer throughout the self-assessment and application processes, and an insurer is expected to provide a frank self-assessment relating to any ICM inadequacies and any plans to address these over time. Where some inadequacies remain to be addressed at the time a final decision is required, the Authority may provide a 'conditional approval' that will allow an insurer to use its ICM for regulatory capital purposes while any remaining issues are being addressed. However, an insurer should recognise that the evaluation of an ICM is a rigorous process that will require the dedication of sufficient resources in order to be successful.

Affirmation Statements

A.6. Checking the box for each item below indicates that the insurer substantially complies with the statement listed. Comments relating to the insurer's compliance are encouraged and should be attached to these affirmations.

A.7. Use Test

A.7.1.	The ICM is an essential component in the development and evaluation of the insurer's strategies.	<input type="checkbox"/>
A.7.2.	The ICM is relied upon for key management and tactical operating decisions.	<input type="checkbox"/>
A.7.3.	The ICM is an integral part of the insurer's risk and capital management functions.	<input type="checkbox"/>

A.8. Statistical Test

A.8.1.	The ICM has been developed with due regard to generally accepted actuarial techniques and statistical theory.	<input type="checkbox"/>
A.8.2.	All material assumptions have been assessed for veracity and suitability.	<input type="checkbox"/>
A.8.3.	Rigorous data validation procedures are in place.	<input type="checkbox"/>
A.8.4.	Modelling techniques are appropriate to the nature, scale and complexity of the risks to which the insurer is exposed.	<input type="checkbox"/>
A.8.5.	The ICM reflects the complete risk position of the insurer in all material respects.	<input type="checkbox"/>
A.8.6.	The ICM has a rigorous approach to modelling dependency structures.	<input type="checkbox"/>

A.9. Calibration Test

A.9.1.	The ICM is calibrated to produce an estimate of the capital required using the Tail Value-at-Risk ⁷ (TVar) metric subject to a confidence level of 99.0% over a one year period with run-off of all liabilities. (An alternative metric may be used as long as it can be demonstrated that it provides for at least an equivalent level of capital.)	<input type="checkbox"/>
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A.10. Validation

A.10.1.	The ICM is subject to a regular cycle of validation, which includes the monitoring of performance, review of the ongoing appropriateness of model specifications, and testing of forecast results against experience.	<input type="checkbox"/>
A.10.2.	The validation process demonstrates that the ICM remains suitable for the purpose intended during changing conditions.	<input type="checkbox"/>

A.11. Documentation

A.11.1.	Documentation of the ICM provides a detailed description of the structure, design, theory, operational details, input assumptions, parameters, governance process and controls of the ICM.	<input type="checkbox"/>
A.11.2.	The documentation is sufficiently comprehensive and instructive such that the ICM can be utilised and maintained by newly assigned personnel or personnel with limited user experience.	<input type="checkbox"/>

⁷ Tail Value at Risk, or TVar, at x% is the expected loss given the xth percentile loss is breached. A 99.0% TVar level therefore corresponds to the average of the largest 1% of modelled outcomes.

A.12. Model Governance

A.12.1.	The Board and senior management of the insurer have overall responsibility for the design, maintenance and use of the ICM.	<input type="checkbox"/>
A.12.2.	There is sufficient understanding of the ICM at the appropriate levels within the insurer.	<input type="checkbox"/>
A.12.3.	The Board and senior management of the insurer possess a detailed understanding regarding the implications of ICM outputs and its limitations for risk and capital management decisions.	<input type="checkbox"/>

A.13. Internal Controls

A.13.1.	There are sufficient internal controls in place to monitor and evaluate the ICM's efficient operation and maintenance.	<input type="checkbox"/>
A.13.2.	Strict protocols are in place restricting those persons who have access to the ICM and the ability to make adjustments thereto.	<input type="checkbox"/>

A.14. Risk Categories

A.14.1.	The ICM adequately captures all the material risks facing the insurer, including, but not limited to, catastrophe risk, underwriting risk, reserving risk, market risk, liquidity risk, credit risk and operational risk.	<input type="checkbox"/>
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Guidance for Affirmation Statements

Use Test

A.15. The Authority will not approve an ICM unless it is satisfied that the model is central to the insurer's decision-making process and is embedded in its operations. This is referred to as the "Use test" and requires that an ICM be widely used throughout an insurer's organisation and serves a critical role in the development, implementation and monitoring of management strategies.

A.16. The ICM should assist management in the identification, measurement and management of all material sources of risk and be used to indicate potential actions to ameliorate unsatisfactory risk exposures. The ICM should also be used by the insurer to better understand the alignment of exposures across different risk drivers.

A.17. The Authority expects that the ICM will typically be used for the following business purposes:

- evaluation of capital adequacy;
- allocation of capital to business segments and lines of business;
- determination of hurdle rates of return for pricing and underwriting guidelines;
- determination of marginal capital or hurdle rates of return for large or special accounts;
- determination of risk appetite, including management of risk limits and portfolio composition;
- assessment of outward reinsurance strategies;
- development and evaluation of business plans, including new lines of business or new areas of risk;
- capital management;
- determination of investment policies and strategies; and
- performance assessment.

A.18. The ICM should contain processes and reporting that enables the insurer to monitor, manage and report on the individual and aggregate risks, to which the insurer is or could be exposed, as well as the dependencies between risks.

A.19. The ICM should also serve a central role in terms of corporate governance, particularly as it relates to the risk management function and decision-making processes.

- A.20. The Board and management of the insurer should possess an overall understanding of the ICM architecture, its key assumptions and the relationships between drivers of risk.
- A.21. A broad involvement of a range of business functions should exist in the use of the ICM, including executive management, actuarial science, risk management, finance, underwriting, claims and human resources, particularly for performance-based compensation. Each business function should understand how its areas of responsibility are reflected in the ICM and how past experience will impact capital requirements.
- A.22. There should be an adequate recognition of the limitations of modelling processes, given the range of factors considered in management's decision-making process and the inherent limitations of ICMs. The Authority would expect the ICM to be used as an input into, rather than the sole determinant of, key management decisions.
- A.23. The frequency of determination of the RCR using the ICM should be consistent with the insurer's needs, but should be assessed at least annually.
- A.24. The use of and reliance upon the ICM should be extensive enough to result in continuous feedback on the reasonableness of its results and the validity of the model's inputs and critical assumptions.

Statistical Test

- A.25. The methodologies used in the ICM should be based on rigorous actuarial and statistical techniques, be consistent with the methods used to calculate technical provisions and use current and credible data as well as realistic assumptions.
- A.26. Processes should be in place to review all ICM inputs and assumptions for reasonableness and consistency. In addition to considering process risk, the model's assumptions and parameters should be determined taking into consideration parameter risk and data quality. Where practicable, goodness of fit testing of the ICM with historical observations should be conducted to assess the model's efficacy.
- A.27. Dependencies within and among risk categories should be adequately considered in the ICM. The insurer should be able to justify diversification benefits between risk categories and provide comprehensive descriptions of the material assumptions and methodologies underlying dependency structures in the ICM. Additionally, an insurer should be able to demonstrate that the ICM adequately captures dependencies between risks during stress testing. Further guidance relating to dependency structures is being developed by the Authority.
- A.28. The interdependency between natural or man-made catastrophes and capital markets should also be considered, as more extreme catastrophes may induce stress on financial markets.
- A.29. The data used both as inputs to the ICM and to determine parameters for the ICM, including exposure data from insurer and broker submissions and industry data from which loss frequency or severity assumptions are derived, should be updated frequently and tested for accuracy, completeness, and predictive propensity.

Calibration Test

- A.30. Where practicable, the ICM should be calibrated such that the RCR is determined using the TVar metric subject to a confidence level of 99.0% over a one year period with a complete run-off of all liabilities.
- A.31. A time period other than one year or risk measure different from the 99.0% TVar may be used, provided the selected metric can be demonstrated to be at least as effective as a 99.0% TVar over a one year time horizon in determining the RCR.
- A.32. If an alternative risk measure is selected, the insurer should give due consideration to its statistical properties. For the purpose of capital requirements, an insurer is encouraged to use theoretically supportable models and coherent risk measures⁸, keeping in mind that Value at Risk measures are coherent only in limited circumstances.
- A.33. Ideally, the ICM should be based on an economic balance sheet that reconciles to the insurer's balance sheet used for statutory reporting purposes.

⁸ A coherent risk measure is sub-additive, monotonic, homogeneous and translationally invariant.

Validation

- A.34. The ICM should be subject to a periodic validation process. This should include a review of its predictive performance, an ongoing assessment of the appropriateness of material assumptions and methodologies, and a review of model output for reasonableness. The review should be completed by senior management of the insurer and should include the comparison of results with actual experience.
- A.35. The completion of an independent internal or external review of the development, operation and interpretation of the ICM is encouraged prior to an insurer's ICM application. A review by an independent external third party is considered best practice.
- A.36. The validation process should include an examination of the sensitivity of ICM results to changes in key underlying assumptions. It should also include an assessment of the accuracy, completeness and predictive propensity of the data used by the ICM. Statistically valid comparisons to historical data should be undertaken to assess the robustness of the ICM, and all implicit assumptions should be made explicit.
- A.37. The ICM should be subjected to a range of scenario and stress tests in order to assess the reliability of the ICM indications and to test the robustness of the model in the evaluation of extreme but plausible events.
- A.38. Stress scenarios may be insurer specific (e.g. concerns with the financial condition of the insurer or claims concentration), industry-specific (e.g. price levels or catastrophic claims) or reflective of market conditions in general (e.g. impaired capital markets). Scenarios considered should also include combinations of interdependent events, such as adverse policyholder behaviour, catastrophic claims and impaired capital markets.
- A.39. The validation process should demonstrate that the ICM remains fit for the purposes intended under changing conditions and continues to satisfy the criteria outlined in the use test, statistical test, calibration test and risk categories sections of this guidance.

Documentation

- A.40. Comprehensive documentation should be maintained by the insurer describing the ICM's processes, theory, material assumptions and operational details.
- A.41. The documentation should be sufficiently comprehensive and instructive so as to support an independent review of the ICM as well as its use and maintenance by newly assigned personnel or personnel with limited experience.
- A.42. Documentation should include a detailed outline of the ICM's structure, including a schematic diagram of its main components, the flow of data between those components, linkages between technical and non-technical elements and the theory underlying its design and function.
- A.43. An insurer should also be able to provide details regarding key inputs and the assumptions used to determine those inputs as well as the relevant outputs and how those outputs are used in the day-to-day operations and management of the insurer. Documentation should also include details relating to the ICM's governance and internal control procedures.
- A.44. Documentation should describe the validation procedures applied to any components of the ICM, and an insurer should document the findings from each validation exercise.
- A.45. Material changes made to the ICM should be documented, and the Authority should be notified of these changes along with any significant policy changes affecting the ICM. In addition, a catalogue of minor or routine changes should be maintained by the insurer and be available for inspection.
- A.46. The documentation should identify any weaknesses of the ICM or conditions for which it may not adequately determine the insurer's RCR.

Model Governance

- A.47. The Board of the insurer should ultimately be responsible for the integrity of the ICM and its role as a key component of the insurer's risk management function. This responsibility may be discharged by the Chief Risk Officer, or the person with responsibilities normally assumed by the Chief Risk Officer.
- A.48. The insurer's Board should be provided with enough information regarding the design and application of the ICM so that they fully understand their responsibilities in relation to the ICM. It is essential that the Board receives up-to-date information regarding the model's performance and all material amendments to same.
- A.49. The insurer's risk management unit and its Board should have a thorough understanding of the ICM's key elements, including the implications of its outputs and limitations for risk and capital management decisions.
- A.50. The insurer's Board should ultimately be responsible for the development and execution of the insurer's business strategies and risk appetites, and the insurer should be able to evidence an appropriate degree of review and challenge of the ICM at Board level.
- A.51. The insurer's risk management unit and its Board should be responsible for ensuring the ongoing appropriateness of the design and application of the ICM, and that processes are in place to amend and refine the ICM as an insurer's risk profile changes.
- A.52. The risk management unit of the insurer should have sufficient resources, technical ability and authority to operate and maintain the ICM effectively and securely. The insurer's emergency management and business continuity plans should include specific provisions for the backup and recovery of all critical systems needed for the continued operation and maintenance of the ICM.
- A.53. The risk management unit should test and validate the ICM on a periodic basis. This unit should also document any subsequent changes made to the ICM, inform senior management and the Board of the insurer about the performance of the ICM, and recommend areas needing improvement.
- A.54. An insurer should decide on the appropriate balance of in-house versus external expertise relied upon in relation to the ICM, given the nature, scale and complexity of the risks they bear. Any outsourced work should meet the insurer's own quality requirements and should be appropriate to the nature of the insurer's business.
- A.55. The insurer should maintain written documentation of all ICM governance policies and procedures, including organisational risk limits and tolerances, internal control, internal audit and, where relevant, outsourcing of ICM activities. The insurer should further be able to demonstrate that these policies have been periodically reviewed and adhered to in all material respects.

A.56. An insurer should also be able to demonstrate the ICM's degree of integration into the governance process by providing evidence of links between the risk management function and the model. These linkages should clearly illustrate the involvement of the risk management function in the construction and design of the model, and the ICM's role in supporting key risk management decisions, including those relating to risk-based capital assessment and allocation.

Internal Controls

- A.57. An insurer should clearly demonstrate that adequate and effective controls are in place in relation to the operation and maintenance of the ICM, including strict protocols identifying those parties who have the authority to use and make amendments to the model.
- A.58. Clearly documented procedures for independent review of the ICM should be developed by the insurer. This process may be completed by an internal audit unit, an external audit service or a combination of both.
- A.59. The scope of the internal control process should include administrative and accounting procedures, testing and control procedures, reporting requirements and compliance procedures.
- A.60. The audit function should include procedures designed to verify that the ICM is current, uses reliable and relevant data and is operated and maintained by personnel with adequate expertise and experience.
- A.61. A specific control policy should also be in effect ensuring that an appropriate segregation of duties is maintained between those who are responsible for operating and maintaining the ICM and those who are responsible for interpreting and communicating its results.
- A.62. The internal control process should also include provisions for the routine review and challenge of material assumptions and parameters in the ICM.

Risk Categories

A.63. The ICM should consider all material risks facing an insurer on a consistent and coherent basis. The risks considered should include the following:

- insurance risk, including catastrophe risk, underwriting risk and reserving risk;
- market risk;
- liquidity risk;
- credit risk; and
- operational risk.

A.64. The ICM should generate capital allocations that accurately reflect the risks inherent in each area of the insurer's business, and improve management's internal reporting capability on such measures as return on risk-adjusted allocated capital, for example.

A.65. Risk mitigation actions such as inuring reinsurance should be considered in the ICM provided that associated credit and other risks are properly reflected.

A.66. The impact of likely future management actions carried out in response to specific circumstances may be incorporated into the ICM provided that due consideration is given to the time taken to implement these actions.

A.67. In order to adequately capture the full extent of these risks, the ICM should provide for the insurer's business to be run-off until extinction. In particular, the ICM should explicitly consider each of the following:

- one year of expected new business writings and renewals with effect from the evaluation date;
- catastrophe risk, credit risk (not related to reinsurance) and operational risk arising over the relevant one year period; and
- the run-off of liabilities to extinction contemplating the catastrophe, underwriting, reserving, credit (reinsurance), liquidity and market risk.

A.68. Risks associated with derivatives, guarantees and any contractual options, where material, should be accurately assessed and reflected in the ICM, including any off-balance sheet exposures.

A.69. An insurer should be able to provide adequate documentation for those risks considered non-material for the purposes of inclusion within the ICM. In cases

where exceptional risks, such as terrorism and pandemic, are not evaluated as a component of the insurer's ICM, the separate review of these risks or support for their exclusion should be available.

Insurance Risk

A.70. Insurance risk is defined as coverage by contract in which one party agrees to indemnify or reimburse another for any fortuitous loss covered under the terms of the contract.

A.71. Insurance risk should be subdivided into three mutually exclusive categories:

- catastrophe risk;
- underwriting risk; and
- reserving risk.

A.72. If an insurer is not able to model and present the risk separately in these categories, it will need to discuss the reasons with the Authority and agree on suitable alternatives in advance.

Catastrophe Risk

A.73. Catastrophe risk is defined as the risk of the occurrence of a man-made or natural event that results in significant insurance losses to multiple exposures at the same time.

A.74. An insurer should be able to provide a description relating to all models used to evaluate its catastrophic loss exposures. This description should consider the following details, among others:

- identity of all vendor models used;
- identity of all region-peril models used;
- specifications of any internally developed models used;
- per occurrence and aggregate annual loss distributions for the insurer's in force portfolio separately by region and by peril for each type of business⁹ and in total (both gross and net basis);
- practice adopted for the modelling of multiple events;
- method for the modelling of terrorism risks, if applicable;

⁹ Where type of business is categorised as insurance, reinsurance, retrocession and insurance linked securities.

- treatment of reinstatement premiums receivable and payable;
- recognition of inuring reinsurance;
- supplemental losses considered by the insurer's catastrophe models (e.g. fire following earthquake, storm surge, demand surge, sprinkler leakage, etc.);
- additional loadings included in each of the models used (e.g. allocated loss adjustment expense, insurance to value adjustments, etc.); and
- non-modelled losses.

A.75. There is potentially systemic risk in the extent of reliance on vendor-provided catastrophe models.¹⁰ An insurer should take precaution and avoid an over-reliance on vendor models without adequate safeguards to monitor and address their limitations. An insurer should be able to demonstrate its knowledge of these limitations and specify the means by which they are addressed.

Underwriting Risk

A.76. Underwriting risk is defined as the risk that the insurer's prospective underwriting activities will result in financial loss (both in respect of current in force business as well as business to be written). For the purposes of ICM construction, underwriting risk should be evaluated separately from, and in addition to, catastrophe risk as defined above.

A.77. An insurer should be able to provide a description of the approach to modelling underwriting risk in the ICM, which considers each of the following elements, among others:

- method for the estimation of premium writings;
- consideration of market cycles, which may include changes in premium adequacy as well as terms and conditions;
- methodology adopted for the earning of premiums written;
- treatment of "large" and "attritional" claims, including the method for defining each, the rationale supporting their separate treatment and the parameter risk associated with the estimation of frequency for large claim events;
- impact of reinsurance on large claims, including per risk or horizontal exhaustion of reinsurance limits;

¹⁰ *Survey of Economic Capital Modelling Practices in the Bermuda Insurance Market*, Bermuda Monetary Authority, December 2008, Section 1.5.2.

- likelihood that claims will exceed available reinsurance coverage limits either as a consequence of poor underwriting or an underestimation of potential loss exposure;
- consideration of the variability of attritional losses, including cases where market and economic conditions are more adverse than observed historically;
- details of all material reinsurance programmes, including premiums, limits, reinstatement provisions, commissions, expenses and any other relevant items;
- assumptions regarding the expected cost and availability of inuring reinsurance in future periods; and
- dependency between underwriting risk segments and accident periods.

Reserving Risk

A.78. Reserving risk is defined as the possibility that technical provisions for claims liabilities arising from past exposure periods will be inadequate to satisfy their ultimate cost.

A.79. An insurer should be able to provide a description of the manner by which reserving risk is considered in the ICM. This description should include the following items, among others:

- likely circumstances for which run-off outcomes could differ materially from held provisions;
- method for modelling the variability in the run-off of liabilities to extinction;
- manner in which systemic or extreme issues are treated;
- method for modelling premium related and claims handling expenses;
- consideration of inuring reinsurance;
- treatment of inflation, particularly with respect to long-tail business;
- impact of changes in future interest rates; and
- consideration of unusual claims that might not be represented in historical claims experience (e.g. latent disease, mass torts, asbestos property damage, etc.).

Market Risk

A.80. Market risk is defined as the risk that an event or series of economic events will impact the value of an insurer's assets or liabilities. The most common source of this risk type relates to interest rate changes, market price changes, exchange rate movements and counterparty default (excluding reinsurance and intermediary creditors).

A.81. An insurer should be able to provide a description of all market risks to which its assets or liabilities may be exposed and the manner by which they are assessed in the ICM. The following items, among others, should be considered in this description:

- determination of market rate scenarios (e.g. investment asset returns, foreign exchange rates, etc.);
- details relating to any market scenario generators used by the insurer;
- consideration of adverse economic scenarios on both assets and liabilities simultaneously;
- currency units used for all indicators of inflation;
- simulated foreign exchange rates applied to assets and liabilities;
- whether the credit risk for fixed income securities are modelled separately or as part of market risk;
- details of any material dependency considerations (e.g. dependency between market returns and other risks such as credit default losses, dependency between asset classes, etc.);
- additional risks from active investment management; and
- credit risk associated with any assets for which this risk is not typically addressed in the credit risk module of the ICM.

Liquidity Risk

A.82. Liquidity risk is defined as the risk that sources of cash will be insufficient to meet cash needs under current or future conditions. This risk pertains specifically to the circumstances where a given security or asset cannot be bought or sold when needed at the value carried by the insurer in order to fund an obligation or expense.

A.83. When considering liquidity risk, it is important to seek to match the sources of liquidity within the asset portfolio to the liquidity needs of the insurer's liabilities.

A.84. An insurer should consider whether its risk management function adequately identifies the potential for liquidity issues. Any risk so identified should be considered in the ICM, either in the market risk module or separately.

A.85. An insurer is typically cash flow positive and liquidity issues are rare. However, an ICM should consider events that require an insurer to commit assets in support of related-party guarantees, letters of credit, or other agreements requiring some form of security, which may lead to a lack of liquidity.

A.86. Although the standard approach to economic capital modelling tends to treat legal entity boundaries as largely irrelevant and considers aggregate enterprise risk in relation to aggregate capital resources, an insurer's ICM should consider scenarios where capital may not be transferable across legal entities.

A.87. An insurer should be able to provide a description detailing the treatment of liquidity risk in the ICM. The following are examples of possible scenarios that should be considered in this description:

- large claims resulting from a single event or a series of contagion events;
- extreme catastrophic event(s) combined with related financial market stress;
- insurer financial strength ratings downgrade (e.g. full "letter" downgrade or downgrade to non-investment grade levels, etc.);
- impact of the requirement to post collateral to counterparties (e.g. as a result of a ratings downgrade, a single large loss or series of losses, etc.);
- unexpected termination of a material agreement or relationship (e.g. significant reinsurance programme, credit facility, etc.);
- liquidity needs arising from a large operational loss event;
- loss of a key distribution channel; and
- impairment of capital markets.

Credit Risk

A.88. Credit risk is defined as the risk of loss arising from the inability to realise amounts due from creditors, including reinsurers and intermediaries. Certain credit risks, such as those relating to publicly traded assets, may be captured in the market risk module, in which case they do not need to be addressed as part of the credit risk module.

A.89. An insurer should be able to provide a description of the manner by which its ICM considers credit risk, which includes, but is not limited to, the following:

- main sources of credit risk, including premium debtors, financial agreement counterparties, non-tradable assets, related-party exposures and reinsurance receivables;
- capture of assets or any other relevant items, including off balance sheet items not included in the market risk module;
- residual credit risks that are only partially covered in the market risk module;
- method for assessing extreme credit risk events;
- evaluation of credit risk exposures over the entire holding period of each asset;
- consideration of reinsurance receivables;
- dependency assumptions (e.g. between defaults on different asset classes, between insurer defaults and claims levels, etc.); and
- assessment of mark-to-market credit risk impacts, including both the impact of widening credit spreads and ratings migration.

Operational Risk

A.90. Operational risk is defined as the risk of loss resulting from failed or inadequate internal processes, personnel, systems, or external events.

A.91. Operational risk is a key component of an insurer's risk profile. The Authority recognises that quantification of operational risk is a developing discipline. Accordingly, the operational risk module may be developed and operated separately from the other risk modules and differ from those modules in its level of complexity.

A.92. The risk management function of an insurer should be able to identify, measure, respond to, monitor and report on all material operational risks, and these risks should be considered in the ICM.

A.93. Ideally, an insurer should consider risks arising from each of the following factors, which are described in the Authority's Commercial Insurer Risk Assessment ("CIRA") framework, when assessing its operational risk:

- a. **Business Process Risk** which includes data entry and data processing errors arising from application design misspecifications;
- b. **Business Continuity Risk** which includes risks that threaten or disrupt an insurer's continuous operations, such as risks arising from natural and man-made hazards;
- c. **Compliance Risk** which includes legal and regulatory breaches;
- d. **Information Systems Risk** which includes unauthorised access to systems and data, data loss, utility disruptions, software and hardware failures, and inability to access information systems;
- e. **Distribution Channels Risk** which includes inexperienced or incapable brokers/agents;
- f. **Fraud Risk** which includes intentional misconduct or unauthorised activities such as misappropriation of assets, information theft, forgery, and fraudulent claims;
- g. **Human Resources Risk** which includes key person risk, unethical staff (not including fraud), inexperienced or incapable staff, training, retention, and communication failures; and
- h. **Outsourcing Risk** which includes communication failures, and incapable outsourcing partners.

A.94.If operational risk is explicitly modelled using historical data, an insurer should be able to describe the sources of data used for the assessment of operational risk, including:

- internal loss and event data;
- external loss and event data with details of any external data providers; and
- scenario analysis.

A.95.There may be an overlap between operational risk and other risk categories. If the losses are considered elsewhere in the ICM, the insurer should be able to provide sufficient documentation to evidence this.

A.96.Where significant losses have occurred as a result of prior operational events, the insurer should describe practices put in place to mitigate against similar losses in the future.