



Model Risk Management -

Achieving better compliance with Hong Kong regulatory standards through benchmarking to PRA Supervisory Statement (SS) 1/23

01

What is Model and Model Risk?

The global use of complex financial models has proliferated across industries as organisations increasingly rely on these tools for a wide range of decision-making and analysis purposes.

'Model'

Referring to the latest definition published by the Prudential Regulation Authority (PRA) in SS1/23- Model Risk Management (MRM) Principles for Banks, which became effective in May 2024, the term 'Model' is defined as a quantitative method that applies statistical, economic, financial, or mathematical theories, techniques, and assumptions to process input data into output. The definition of a model includes input data that are quantitative and / or qualitative in nature or expert judgement-based, and outputs that are quantitative or qualitative. In essence, a model consists of three components:

Input Component

delivers assumptions or data to the model

Processing Component

transforms inputs into estimates

Reporting Component

translates the estimates into useful business information

'Model Risk'

PRA SS1/23 also defines 'Model Risk' as the potential for adverse consequences resulting from decisions based on incorrect or misused model outputs and reports.

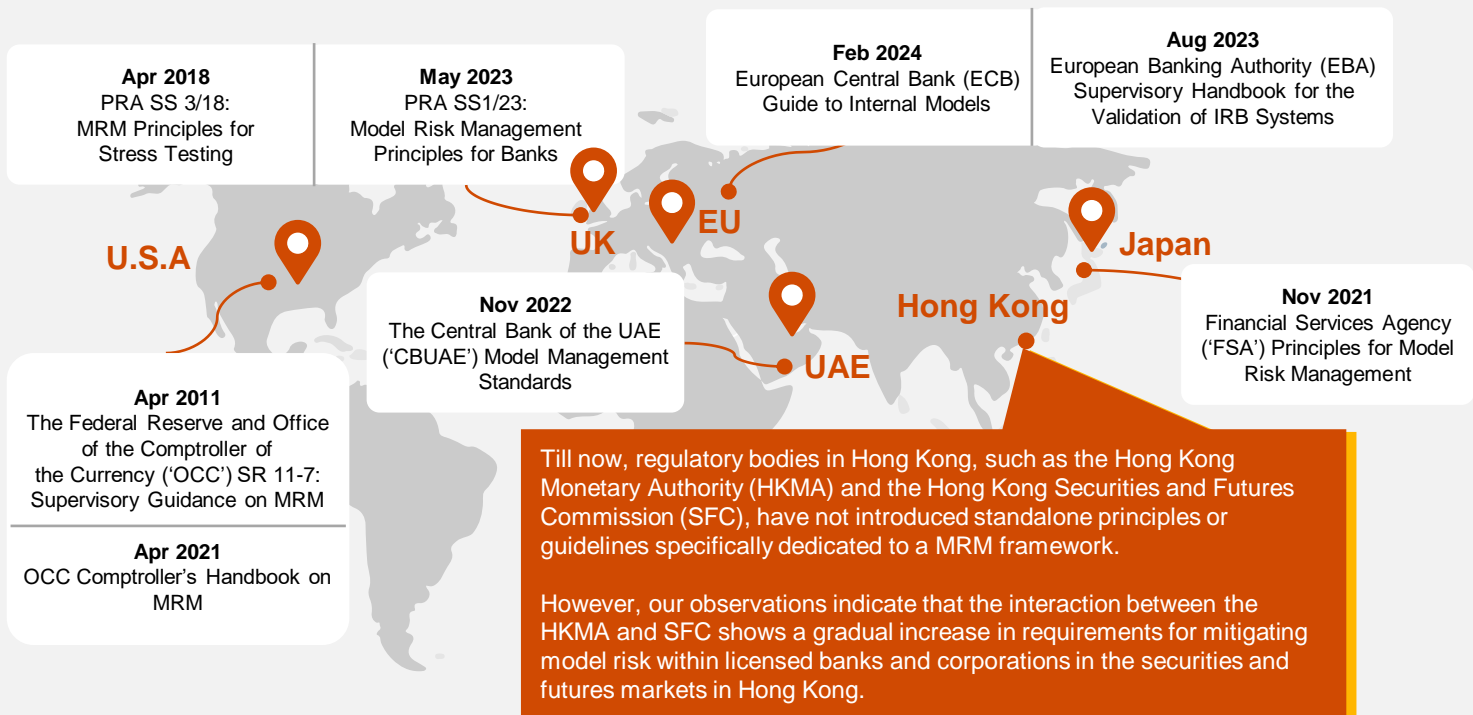
The use of models inherently entails the presence of model risk, which refers to the risks associated with the use of financial, risk, and econometrics models in financial institutions and investment analysis, as identified by the market.

02

Global MRM Regulatory Landscape

As the financial sector undergoes rapid digitisation, robust MRM governance has become a strategic imperative.

Over the past decade, financial regulators worldwide have taken proactive measures to enhance and manage model risk from a regulatory perspective.



Regulatory Requirements related to models in Hong Kong

Over the years, the HKMA has issued minimum standards and requirements for the development, validation, and ongoing monitoring of models. These standards specify the scope and frequency of these activities and are in line with the rules set by the Basel Committee on Banking Supervision (BCBS). The objective is to effectively manage various types of models across different risk categories, including market risk, credit risk, liquidity risk, and emerging risk.

Similarly, in recent years the SFC has released several questionnaires for licensed corporations in Hong Kong regarding the adoption of Over-the-Counter Derivatives (OTCD) market reform. These questionnaires assess the overall readiness of organisations, with particular emphasis placed by the SFC on the development of a model lifecycle framework, governance structure, and the maintenance of a comprehensive model inventory to record all model-related documents.

Regulatory requirements related to models in Hong Kong across different risk categories

Banking requirements on Market Risk– Internal Models

Approach (IMA):

- Role of validation party to be independent of risk-taking functions and model development/ implementation
- Scope of regular backtesting as part of on-going monitoring
- Arrangement for external validation

Relevant documents:

- ❖ Jan 2019 – BCBS Basel III Minimum capital requirements for market risk
- ❖ Apr 2024 – Cap. 155L Banking (Capital) Rules
- ❖ Mar 2024 – HKMA SPM MR-1: Market Risk Capital Charge

Banking requirements on Market Risk– Initial Margin (IM) Models:

- Periodic validation and ongoing monitoring scope
- Continuous monitoring on model performance and annual recalibration
- Timely remedial action for material validation findings

Relevant documents:

- ❖ Sep 2020 – HKMA SPM CR-G-14: Non-centrally Cleared OTC Derivatives Transactions

Banking requirements on Liquidity and Interest Rate Risk– Liquidity and Behavioral Models:

- Board and senior management oversight
- Comprehensive and independent validation at least annually
- Testing of model outputs against outcomes

Relevant documents:

- ❖ Nov 2016 – HKMA SPM LM-2: Sound Systems and Controls for Liquidity Risk Management
- ❖ Dec 2018 – HKMA SPM IR-1: Interest Rate Risk in the Banking Book

Banking requirements on Credit Risk– Internal Ratings-Based (IRB) Models:

- Development and maintenance of an up-to-date model inventory
- Validation should include quantitative and qualitative elements
- Sufficient documentation process for initial and ongoing validation of exposure models

Relevant documents:

- ❖ Jan 2006 – HKMA SPM CR-S-5: Credit Card Business
- ❖ Dec 2017 – BCBS Basel III: Finalising Post-Crisis Reforms
- ❖ May 2018 – HKMA SPM CA-G-4: Validating Risk Rating Systems under the IRB Approach
- ❖ Apr 2024 – Cap. 155L Banking (Capital) Rules

Banking requirements on Emerging Risk– Artificial Intelligence (AI) Model:

- Data governance
- Model and algorithm governance
- Contingency plan implementation
- Third-party vendor management framework
- Three lines of defence in developing and monitoring AI operations

Relevant documents:

- ❖ Nov 2019 – HKMA High-level Principles on AI

SFC requirements on Market Risk – Market Risk Model using IMA:

- Management process of each stage of model lifecycle
- Development and maintenance of firm-wide model inventory
- Model tiering approach design
- Sufficient development of MRM policies and procedures

Relevant documents:

- ❖ Aug 2018 – SFC Circular to Licensed Corporations IMA for Market Risk
- ❖ Oct 2023 – SFC Interim Guidelines / Questionnaire for Market Risk Internal Models Approach

SFC requirements on Market Risk – IM Models (SIMM Approach):

- Establishment of a comprehensive governance framework with sufficient senior management oversight
- Model inventory functions and data interdependency
- Establishment of a model lifecycle framework

Relevant documents:

- ❖ Oct 2023 – SFC Initial Margin Questionnaire

While Hong Kong lacks a prevailing regulatory document that specifies the implementation standards for model risk management, FIs in Hong Kong can refer to established global best practices to enhance their MRM capabilities.

One notable reference is the PRA SS1/23 published by the Bank of England in 2023. It places emphasis on embedding MRM into the organisation, addressing both traditional risk types and emerging risks. In Hong Kong, this global standard gradually serves as an overarching principle and benchmark for peer banks and FIs to follow and implement, particularly in light of the recent regulatory requirements on models introduced by Hong Kong regulators.

Components of MRM at a glance

Drawing on our extensive knowledge of the MRM regulatory requirements published by the HKMA and SFC, as well as our thorough understanding of PRA SS1/23 and vast experience in MRM implementation projects, we have developed a PwC 'point of view' (PoV) that provides a concise summary of the essential elements to be incorporated into a comprehensive MRM framework.

Our proposed framework comprises four key components, complemented by two supporting mechanisms:

PwC's PoV: Essential Elements for a Comprehensive MRM Framework

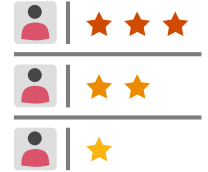
Model Identification

- Establish clear definitions of 'model risk', 'model' and 'non-model', to determine the scope of MRM framework.
- Establish appropriate controls on quantitative approaches that are classified as 'non models'. (i.e. decision-based rules or algorithms which have a material bearing on business decisions- PRA SS1/23)



Model Tiering Design

- Develop a uniform and firm-wide risk-based approach to ensure the frequency of the periodic model validation and monitoring is commensurate with the model materiality and complexity.
- Model materiality considers both quantitative size-based measures and qualitative factors associated with the model's purpose. On the other hand, model complexity considers the risk factors that affect a model's inherent risk.



Model Lifecycle Management

- Develop robust processes and procedures to govern each stage of the model lifecycle: (1) Model Development, Implementation, and Use, (2) Model Validation, (3) Model Monitoring and (4) Model Change and Retirement.
- Identify and apply different treatments to internal and external models across the model lifecycle.



MRM Governance Framework

- Define the responsibilities of the board of directors, senior management, supervisors, and committees.
- Define roles and responsibilities of identified stakeholders within the three lines of defence.
- Define interactions between parent and subsidiary levels for efficient MRM operation within an organisation.



Supporting Mechanism of MRM

Model Inventory Design and Implementation

- Develop a firm-wide model inventory which captures complete and accurate information on all models. (e.g. model scope, inputs, outputs, limitations or restrictions on its use, etc.)
- Embed functionalities to identify model interdependencies for enhanced understanding of aggregate model risk.



MRM Policies and Procedures

- Establish policies and procedures to govern all aspects of MRM activities throughout the model lifecycle and model inventory management.
- Develop policy sign-off mechanism and review frequency for all MRM policies and procedures.
- Establish and maintain adequate documentations to ensure effective model risk assessment.



In the rapidly transforming financial industry, the significance of comprehensive MRM practices has become paramount. PwC, as a trusted professional service firm, has been a reliable partner for numerous financial institutions, assisting them in implementing their MRM framework while adhering to leading market principles and regulatory requirements.

Recognising the complexity and challenges associated with MRM framework design and implementation, we have developed a comprehensive and seamless MRM solution package. This package includes the implementation of an enterprise-wide MRM Target Operating Model (TOM), along with the provision of a cutting-edge model inventory tool.

Our featured services include:



MRM Framework Solution Implementation

Based on our proposed key MRM components outlined on page 3 of this flyer, PwC will offer the implementation support of a robust MRM TOM with the following approaches:



MRM Current State Assessment

Targeted review of organisation's existing MRM framework with focus on roles and responsibilities, existing inventory data and lifecycle workflow against regulatory requirements and market best practices



TOM Design on MRM Lifecycle

Construct model risk management target environments based on the gap analysis result



MRM Governance Framework Design

Based on the assessment's results, review and support the update of MRM policy and procedure



Upon completing the TOM design, the organisation will have set clear guidelines for identifying and managing model risks. This empowers the firm to define roles and responsibilities across the three lines of defence throughout the model lifecycle, enabling more effective mitigation of potential model risks.



PwC Model Inventory Application

We offer the PwC Model Risk Manager application to complement your MRM framework. The app serves as a control framework around the management of models. With this model risk management tool, your organisation can organise, track and monitor all models used across the organisation in a user-friendly environment.

Main functionalities of the App

1. Model Inventory

- **Model database:** A structured database of all models available in your institution and related key model attributes
- **User roles:** It supports multiple roles, such as model owners and developers
- **Finding tracker:** List of key model findings
- **Documentation:** It stores all related models
- **Auditability:** All historical actions and changes are stored

Model ID	Description	Status	Risk Rating
MRM-001	MRM Framework Design	Completed	Low
MRM-002	MRM Current State Assessment	In Progress	Medium
MRM-003	MRM Governance Framework Design	Not Started	High

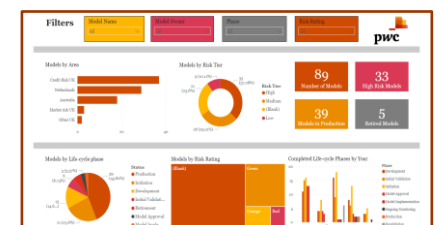
2. Model work-flow

- Essential logic of the model lifecycle is enforced through core phases in predefined relationships
- Possibility to set up a simpler workflow by omitting certain phases in the tool's standard settings
- Automatic notifications and a four-eyes principle (key actions reviewed by particular independent users)

Phase	Status	Start Date	End Date
Model Design	Completed	2023-01-01	2023-01-15
Model Development	In Progress	2023-01-16	2023-01-31
Model Testing	Not Started	2023-02-01	2023-02-15
Model Deployment	Not Started	2023-02-16	2023-02-31

3. Reporting

- The tool provides management with a standardised report at aggregate level
- The report shows high-level information regarding model risk and model lifecycle phases
- For custom reporting, the tool can be linked with third-party reporting tools, such as PowerBI or Tableau



Benefits of MRM to Financial Institutions

The increasing adoption of models within the financial sector has underlined the importance of robust MRM practices for financial institutions. Establishing a comprehensive MRM framework goes beyond mere compliance and offers various benefits. Cultivating a culture of model risk management enables organisations to enhance their understanding and control of model-related risks, thereby gaining a competitive edge in the intricate financial landscape. Some potential competitive advantages include:

01 Ensure Sufficient Model Oversight and Ongoing Compliance

- By implementing a robust MRM framework and maintaining a comprehensive model inventory, financial institutions can improve operational efficiency through a mandatory and streamlined stock-take process for their firmwide models.
- This approach prevents model omissions, enhances oversight capabilities for timely reporting of model risks, facilitates prompt issue resolution, and ensures ongoing regulatory compliance.

02 Improving Stakeholder Ownership and Model Performance

- In the past, the absence of clear definitions for stakeholder roles and responsibilities within organisations may have led to challenges regarding stakeholder identities and model accountability.
- Establishing clear ownership and reporting lines throughout the model lifecycle is essential for effective governance. This enhances model performance and accuracy by implementing well-defined validation and monitoring roles and procedures, and also enables organisations to effectively utilise new models in the future.

03 Enhance Model Auditability and Clarify

- Effective MRM procedures can help organisations prevent model deficiencies and output errors by ensuring clear tracking and understanding of model inputs, assumptions, and outputs through standardised documentation.
- Consistent documentation practices improve model clarity, making them more accessible and understandable for stakeholders. This increases transparency, supports model auditability and fosters a resilient organisational culture.

Contact

We would be happy to discuss Model Risk Management in more detail and explore how it could benefit your business. Please feel free to reach out to us if you have any queries.



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