



Model Risk Management toolkit

**Sound practice and current challenges
for financial institutions**

KPMG International

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Managing models in financial services

The global financial crisis showed us that model risk is real and that the consequences can be far reaching. In response, regulators have increased scrutiny to ensure that financial institutions maintain effective and sustainable Model Risk Management (MRM) programs.

Demonstrating not only the validity of individual models but also the efficacy of the controls covering the design, development, revision, and use of models is of paramount importance. Many organizations are struggling to meet this mandate given the size and complexity of the typical model portfolio, the increasing use of algorithms and the sophistication of underlying technologies, and the diversity of the environments in which they are used.



“This brochure focuses on MRM within the banking sector, but KPMG professionals have increasingly seen Insurance and Asset Management firms also considering this topic, in which a lot of the components and lessons learned from the banking industry can be applied...”

“KPMG’s Model Risk Management approach offers a practical framework for identifying, quantifying, and mitigating model risk by addressing the sources of risk head on”.



Model risk management toolkit

KPMG member firms have developed an MRM toolkit which is designed to provide guidance on implementing an effective Model Risk Management function and framework within a financial entity. The guidance aims to help banks understand the importance of model risk, how it may affect the P&L and capital and the most important steps to develop a model risk framework.

The MRM toolkit provides guidance which can be leveraged by financial institutions relying on the use of models, including banks, insurance firms and asset management companies.

This playbook is applicable to banks of all sizes. Given that the level of maturity in institutions on this topic is different and according to the proportionality principle, it is important to tailor the application of this guidance to the nature and circumstances of the entity in question, for example in deciding whether to apply the full scope of the Toolkit or not.

Due to the intense demands of the last few years, some banks have responded to model risk issues with limited stopgap solutions, e.g. dedicating resources for a short period to quickly fix issues. Many banks are now raising the bar in terms of efficiency of their MRM systems and processes, while infusing model risk considerations into their organizations from the board of directors to the business units.



01 Key challenges for banks

The global financial crisis showed that controls and governance frameworks associated with valuation, risk and other model types can be fragmented, incomplete or unreliable. Focus has now shifted to the ways in which banks can prevent or mitigate such instances, for example through an effective model risk management program.

Given the background of the financial crisis and supervisory concerns regarding model risk, many financial entities have decided to create a model risk governance function that is distinct from the existing areas of internal validation and operational risk.

The **main steps to create a MRM function** include the following:

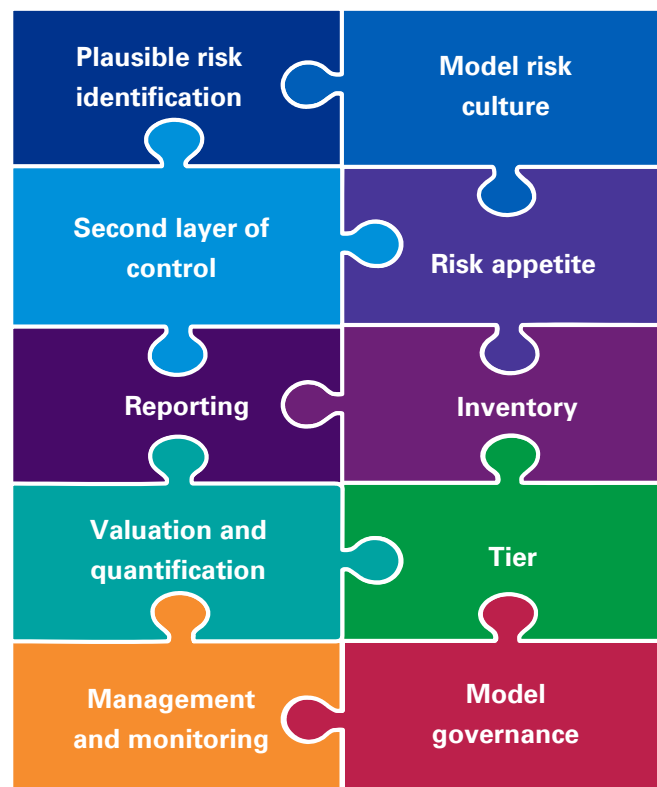
- Locate where the model risk function will sit within the wider organization (i.e. operational risk, second line of defense (2nd LoD), internal validation, sole function, etc.).
- Develop a model risk framework.
- Develop a model inventory & tiering.
- Develop standardized reporting.
- Promote MRM culture across the entity.
- Establish policies and documentation.

“Model risk culture is partially embedded in the financial industry. However, there is often not a formal risk function which gathers all model relevant information in a comprehensive way.”

“Model Risk Management is located in the 2nd LoD complementary to Internal Validation function.” As banks address these issues, a Version 2.0 of MRM is starting to emerge. The importance of managing model risk in programs is becoming more effective and efficient and more widely understood throughout the organization.

Key benefits of having a Model Risk function include:

- 1  Robust governance framework and a standardized process to be able to manage model risk.
- 2  Creation of an inventory which includes all models, tools and even one-off usages, taking into account their materiality / tier.
- 3  Identify all risks associated to data, methodology, implementation and use of the models.
- 4  Model risk assessment and quantify its impact in terms of P&L, capital, etc.
- 5  Standardized reporting system, dashboards and controls which mitigate risks.



02 Regulatory landscape

In recent times some banks have suffered significant financial losses due to inadequate models or wrong model use. Additionally the importance of models for business decisions is growing. Consequently regulatory requirements are set up to control model risk to ensure senior management relying on the use of these model outputs to make informed decisions are aware of the limitations and assumptions of most material models.

Losses by models

In the recent history, several risks events happened to banks due to ineffective model risk management that lead to big losses or bankruptcy.

Use of models

- Technological innovation.
- Competitiveness in the financial industry.
- Inclusion of models in decision making processes.
- Regulatory pressure.
- Demand of greater sophistication in risk management.

Supervisor requirements

- Regulators are issuing guidelines and recommendations to control model risk management in order to:
 - Define what is a model and model risk.
 - Spread model risk culture in the Entity.
- Establish a common framework and Senior Management and Board involvement

Background and current regulation

Canada

The Office of the Superintendent of Financial Institutions Canada

UK

Bank of England/ PRA – Supervisory letter on stress test model management

Poland

KNF - Recommendation W

! US regulators were the **first ones to adopt model risk guidelines**. However, the **ECB** is also **moving towards the implementation of model risk standards**.

EEUU

American Regulators (FED) were leaders issuing regulations about model risk management:

- SR 11-7 (April 2011)
- SR 15-18 (Dec. 2015)

Europe

Recent publication of the ECB's **Guide on Internal Models** (Mar 2018) suggests the **implementation of model risks standards**. CRD & CRR.

In addition to the model-risk specific guidelines, there are a number of additional regulations which will have an impact on model risk:

LIBOR Transition

Libor Market Model Calibration. A transition to a new reference rate may change the discount rates used in models.

FRTB

New Internal model approach. Supervisors will review the use of internal models at desk level. More rigorous model approval process.

SS3/18

Firms should be able to verify that activities conducted by external resources are in accordance with their MRM standards.

SS5/18

The PRA published a supervisory statement on Algorithmic Trading outlining expectations on the risk management and governance of Algorithmic trading models.

TRIM

seeks to improve the supervision of internal Models.. Future supervisory expectations could be higher and delays in approving material model changes are expected

Basel IV

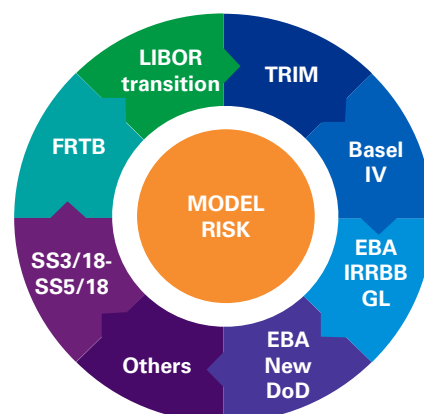
Basel IV changes the approaches to the calculation of the RWA, regardless of whether the standard or internal approach is used and regardless of the type of risk

EBA IRRBB GL

In the new Guideline, the EBA recognizes the importance of models regarding IRRBB. In particular, the required scope of independent model validations has been extended and specified. This includes initial validations before implementation of new models as well as ongoing validations and benchmark assessments.

New Definition of Default

Model change for IRB Models. Recalibration of PD, LGD and CCF.



03 MRM framework



MRM framework



Entities use models to support decision making, financial and regulatory reporting, and to provide predictive information in a number of business functions, this is why they are exposed to potential risks arising from the use of models and need to establish an appropriate framework for managing it.

Establishing a Model Risk Management framework allows an entity to set out a comprehensive approach to managing and controlling model risk:

Tiering & quantification

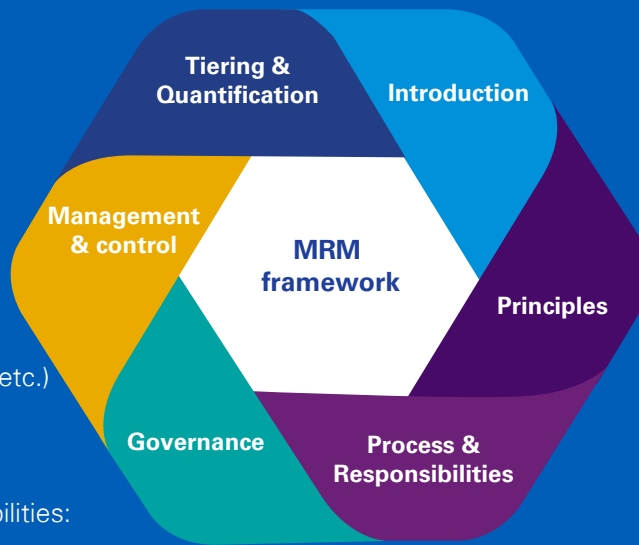
- Model risk tiering and its relevance
- Model risk assessment (quantitative/qualitative)

Management & control

- Documentation
- Model Inventory
- Other model risk tools (Validation, development, etc.)

Governance

- Committees & Responsibilities:
 - Board
 - Global Risk Committee
 - Model Risk Committee



Introduction

- Objective of the framework
- Model's definition
- Model scope
- Model risk definition

Principles

- Line of defense in model risk management
- Board and Senior Management involvement in model risk

Process & responsibilities

- Model lifecycle definition at high level
- Stakeholders involved and their duties

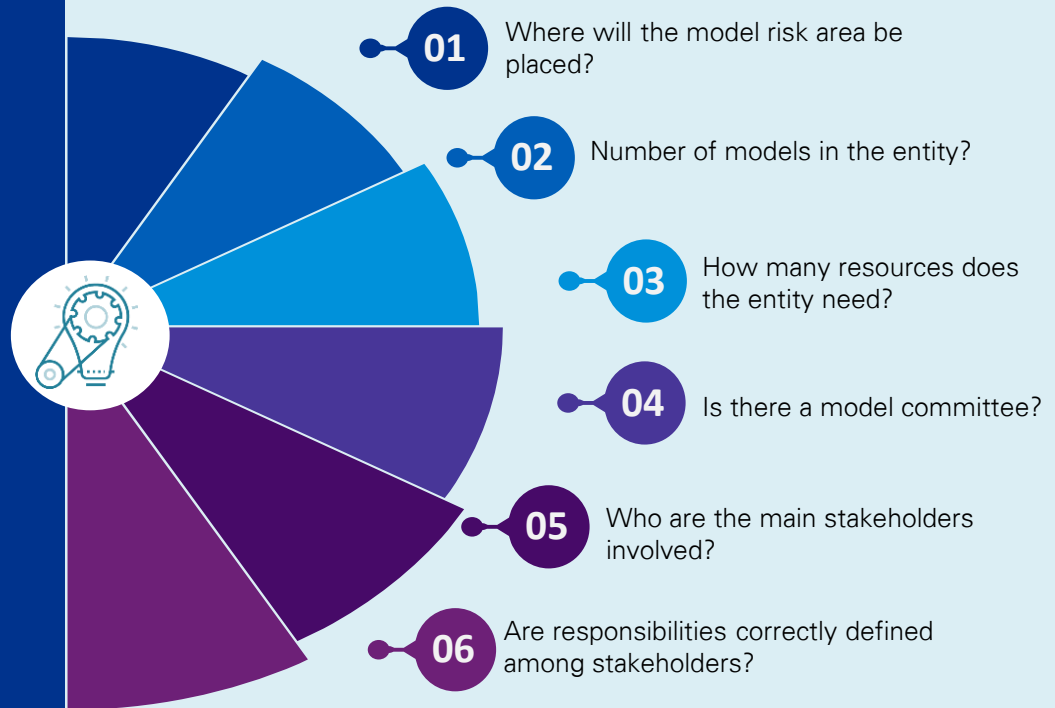
The Key components of a preferred practice MRM framework include:

1	Governance	<ul style="list-style-type: none"> — Senior management oversight. — Clear definition of roles and responsibilities. — Escalation procedures. — Independent model validation & Internal audit review.
2	Model risk culture, strategy and Appetite	<ul style="list-style-type: none"> — Embedded Model risk culture programme across the organization. — Model risk strategy. — Risk Appetite Framework. — Limits and early warnings to KRIs.
3	Policies & Procedures	<ul style="list-style-type: none"> — Develop policies and processes to ensure consistency of standards across the organization. — Review and update the internal documentation frequently. — Provide employees the internal documentation for ongoing use to support model risk management.

The framework and policies established by model risk governance should include standards for model development, controls, implementation, use, and validation.

The Board should approve model risk management policies and review them annually to ensure relevance and consistency.

Bank's board and senior management should establish a strong model risk framework.



The main components that are integral to a strong governance framework for the model risk function include:

Function placement	Organizational structure	Committees	Roles and responsibilities	Resources
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Model definition and taxonomy

Model Risk Function is responsible for the development of the models taxonomy within the entity. Taxonomy should cover all the models that can be included in the inventory and should be subject to regular review in order to make any changes or modifications deemed necessary.

There is inherent subjectivity in deciding which calculation methods fit the definition of a model. As such, firms regularly do not apply their chosen definition consistently. To mitigate this there should be an auditable process in place for the implementation of the adopted model definition, which includes input from developers and the MRM group.

Firms are encouraged to clearly document the rationale and assumptions behind a decision as to whether a particular calculation mechanism constitutes a model, including how they are treated for validation and review purposes. Some key risk initiatives are not necessarily considered as a model (i.e. RDA Certification); but they should be reviewed and included in the Control Risk Framework.

04 Model documentation, inventory and tiering

One of the key elements in effective model risk management is the development and maintenance of model documentation. Without adequate documentation, model risk assessment and management will be ineffective.

Documentation of model development and validation should be sufficiently detailed so that parties unfamiliar with a model can understand how the model operates. Documentation can be a resource and time intensive exercise, however we are observing the use of technology solutions to automate part of the process.

A model inventory should be a central repository of information on all models that are under development, in production and recently retired. It provides senior management with a holistic view of all models used by a firm and helps facilitate other processes in the MRM framework. The information presented for each model should be consistent and broad-ranging enough to enable efficient reporting.

Model documentation

Effective documentation includes a general description of the model. The general description should be of such a nature as to provide a high-level understanding of how the model fits the business, of the risks inherent in the model, and of the controls implemented to address these risks. Some of the items useful in the model description include: model purpose inputs, outputs and intended users.

Model owners and developers are responsible for producing effective documentation.

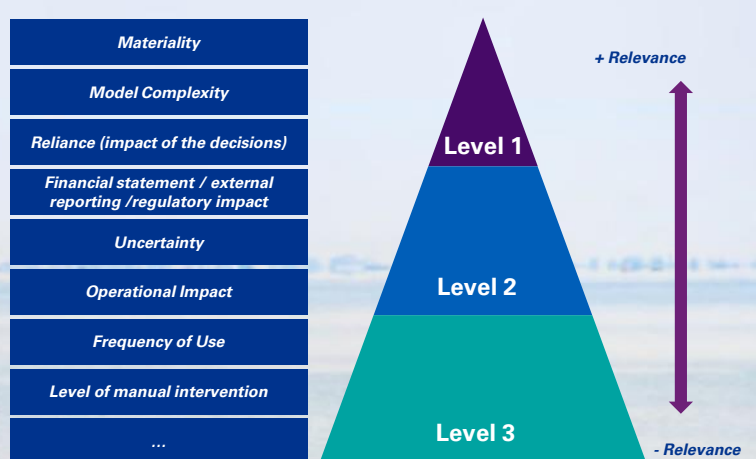
Model inventory

The inventory needs to identify and facilitate the tracking of a model’s status throughout its lifecycle. Details regarding recent validations, such as the date and outcome of the most recent validation and the date for the next review, should also be provided along with the model risk tier. We have included a table containing a comprehensive list of the fields we would expect to see in a best-practice model inventory. We note here that the level of detail provided for each model should be proportionate to the complexity and overall level of usage of the model within a firm.

Model tiering

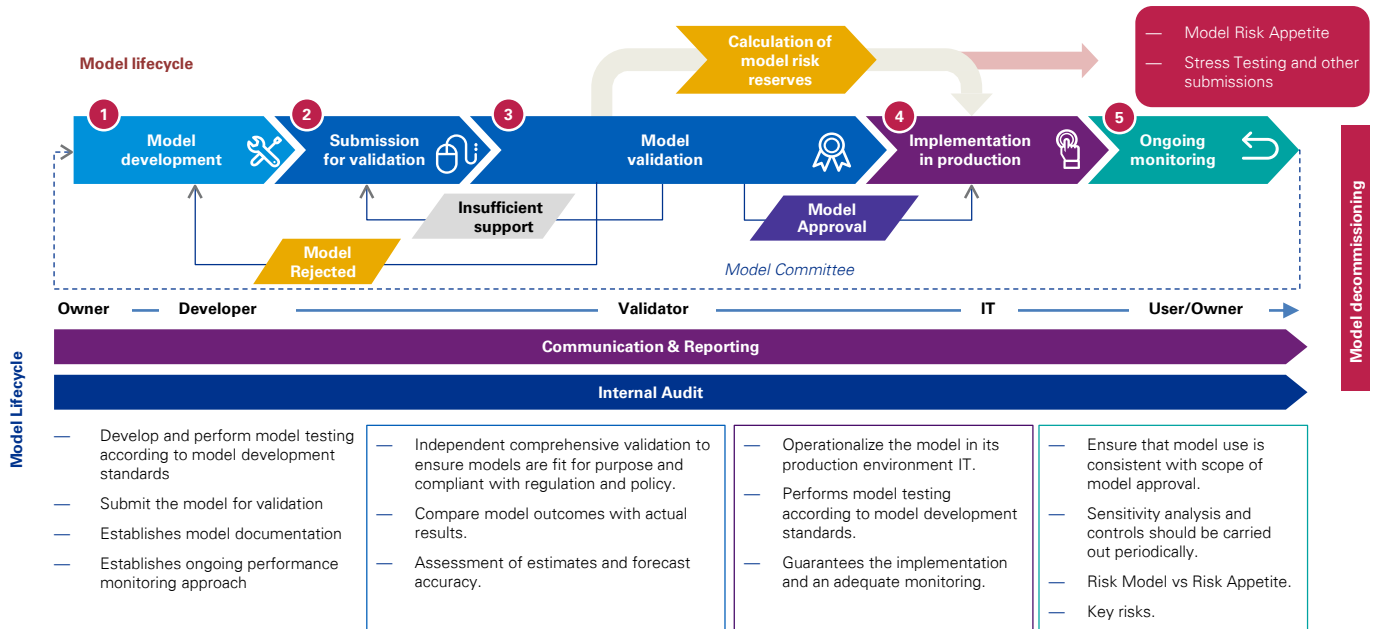
Institutions apply an internally developed model classification methodology to prioritize the nature and extent of model validation and/or review procedures. Classifications are generally formulaic or scorecard-based, with a risk ranking (e.g. High, Medium, or Low risk types).

Regulators expect transparency in the classification methodology, the use of limited subjectivity, and clear documentation of all assumptions and rationale for conclusions.



05 Model life cycle

Regulatory guidance is not prescriptive but principles based, with organizations having the freedom to interpret and tailor roles and responsibilities to suit the business. However, KPMG member firms are seeing a consensus opinion emerge in best practice...

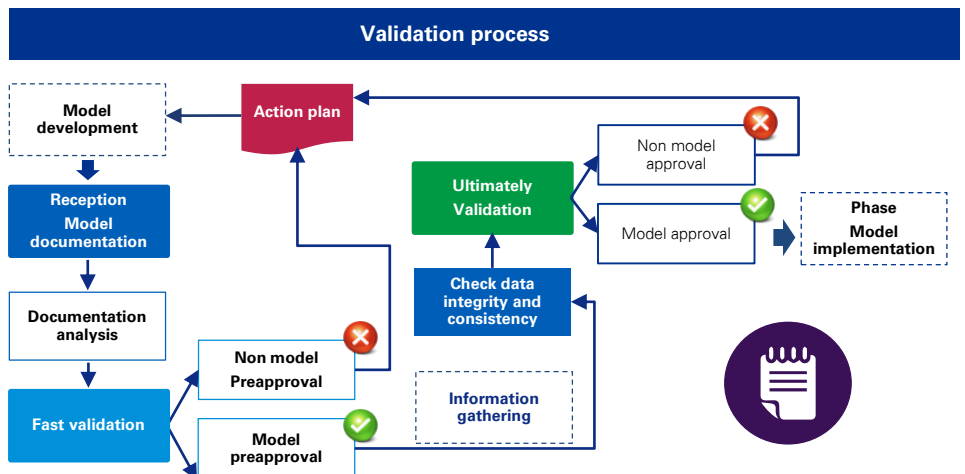


The MRM Policy must set out the activities each stage of the model lifecycle, governance and accountability.

A proper management of the model lifecycle intends to ensure that appropriate controls are in place to mitigate model risk.

All stakeholders need to be aware of model risk that may be generated in each of the model lifecycle phases, even when the model is in already in force.

All models at all risk levels should initially be subject to full validation by the model validator. Financial entities should validate models according to their Tiering. It means we typically observe Tier 1 models are fully validated and Tier 4 models are partially validated or validated on a lower frequency (lack of resources, timing and model importance). Model validation practices vary based on the classification.



06 Communication

External communication with supervisors and regulators is one of the **key challenges for Tier 1 banks** in the improvement of the current model risk management framework. It is also very important to embed the model risk culture across the organization. For that reason, some banks are including in their MRM framework a **specific function to promote model risk culture and communication** (external & internal).

Model Risk Culture programme	Define and set out roles and responsibilities for a single function that coordinates and leads all contacts with the regulator related to regulatory model management to promote an effective communication with supervisory bodies and with all the stakeholders involved in MRM , strengthening model risk management.	
Potential benefits		Challenges
<ul style="list-style-type: none"> — Broad ranging control of information to share with regulators and other stakeholders (internal & external). — Consolidated view and global oversight. — Agile and effective response to new regulatory requirements and ad-hoc requests: anticipation. — Model risk culture promotion: consistent terminology. 		<ul style="list-style-type: none"> — Deep stakeholders involvement in the process. — Adequacy of the necessary infrastructure and systems to support the communication process. — Coordination between different functions and units. — Organizational changes.

Internal communication is also a key challenge for banks. In this sense, some key aspects arising in relation to model risk management should be appropriately escalated in order to provide information to different stakeholders at the appropriate time.

07 Technological environment

For an adequate Model Risk framework it is essential to have a centralized management system that provides an holistic view of model risk across the organization. It is common for many banks to have some accelerators or internal solutions implemented in their technological environment in order to manage model risk.

- 1 **Need to access the inventory of all entity models** on which risk is wanted to be measured (can be in several different systems).
- 2 Access to all **operational information of these models**, on which the KPIs, KRIs, and other indicators of interest will be measured.
- 3 **Integrate all the information** (which may come from different systems and technologies) **at a common point** where the evaluation of indicators will be performed to **detect alarms**.
- 4 **Information to be integrated may be sensitive** to the period that is collected, which adds **more difficulty to this integration process**.
- 5 **The evaluation and control system of Model Risk should be able to make decisions and perform actions on the models** which are affected by a particular alert. To do this it must be able to access and modify the Model inventory.
- 6 **Availability and access to the complete Model Inventory**, including **relevant information** about each model (model owner, type of risk, materiality...).
- 7 **Traceability of the entire life-cycle of the model** (approval date, implementation date, last validation date...).
- 8 **Validation and internal audit recommendations and the status** of its related action plans in order to carry out a proper monitoring.
- 9 **Integration of metrics to quantify model risk** as well as a **control and warnings system** that guarantees the completeness and adequacy of the information.
- 10 **Reporting system that allows the different decision making bodies to escalate the information** in an appropriate time and manner.

The model risk tool may be developed in a strategic environment (internally or with an external vendor) or considering a tactical solution which is more flexible and economic.

KPMG member firms have developed an in-house solution which is designed to cover all the key components of the MRM framework and can be easily tailored for different client needs.

On the other hand, for more complex entities, KPMG firms have an alliance with SAS. This MRM Solution provides value through a central management and control of model documentation, workflow, and related communications for firm wide models, including SAS and non-SAS models.



KPMG firms have successful track record of providing a broad range of financial and strategic advisory services to clients across a wide array of industries related to model Risk Management.

The MRM toolkit can be useful to link guidance with KPMG Model Risk Management services for potential clients. KPMG's Model Risk Management approach offers a practical framework for identifying, quantifying, and mitigating model risk by addressing the sources of risk head on through:

Model Risk Assessment

Model risk assessment including gap analysis and potential remediation actions:

- Assessment of both the level of compliance to applicable standards, and the "efficiency" of Model Risk Management practices.
- Regulatory & Best Practices check-list.
- Master plan and remediation actions.

MRM framework - TOM

Target Operating Model (TOM) for a model risk framework including core elements of:

- Model definition, classification, inventory and tiering.
- Model Development, Implementation and validation.
- Model risk Control definition.
- Monitoring and reporting (KRIs, dashboards, Risk Appetite Statement and Framework).

Governance enhancements

Support on the definition and implementation of the MRM function considering the following elements:

- Governance and model risk function definition.
- Framework, policies and processes.
- Accountability. 3 LoD support.
- Committees definition and top management involvement.

Model lifecycle management support

KPMG professionals can support the different processes included in the Model lifecycle:

- Accountability for all the stakeholders through the lifecycle.
- Model development: extensive knowledge of all kind of models and risk-types.
- Implementation & validation: automated validation.

Model risk quantification

Model risk quantification considering qualitative & quantitative approaches:

- Model risk quantification techniques.
- Economic capital quantification.

Technological support

Technological support in order to implement the MRM in a bank. Depending on the size and complexity...

- Technological accelerators to manage MRM.
- Strategic MRM solution definition and implementation: several partnership and alliances with external providers (Appian, SAS, etc...).



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Why choose KPMG



KPMG member firms have developed strategic validation and model risk management initiatives at a global level helping clients to be at the forefront of change.



We understand the issues and challenges involved in MRM and KPMG professionals can leverage their experience to deliver tailored services to potential clients.



KPMG member firms have a strong track record in projects related to Model Risk Management.



KPMG professionals in 154 countries and territories around the world.



Global network with subject-matter specialists and support from several Centres of Excellence.