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# **Model Risk Management Guideline**

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## 1. Introduction and scope

Financial institutions are using a growing number of models to ensure efficient day-to-day operations, including in calculating regulatory capital, but also to support or drive decision-making across the different levels of their organizational structure.

This growing reliance on models entails the intensive use of increasingly diverse and complex data from varied sources. More sophisticated modelling techniques are also being leveraged through artificial intelligence and machine learning.

However, the increasingly intensive use of data and ever more sophisticated models may expose financial institutions to increased model risks. Decisions based, in whole or in part, on the outcomes produced by models containing errors or weaknesses could expose a financial institution to significant financial or operational losses. Ultimately, the materialization of model risk could damage a financial institution's reputation, undermining consumer confidence in the institution.

As such, financial institutions must be able to identify, assess, monitor and mitigate model risk. To this end, financial institutions should adopt robust model risk management practices throughout the model lifecycle and apply model risk governance best practices.

Specifically, for financial institutions, taking an enterprise-wide view of model risk implies that good practices should be appropriately applied across the entire spectrum of models that could materially impact the effective conduct of operations that are considered systemic.

This spectrum includes, but is not limited to, regulatory capital models, valuation/pricing models, business decision-making models for risk management, stress testing models and any other material models. In this regard, while the definition of a model may be broad and inclusive, this guideline is based on the proportionality principle whereby applicability is commensurate with the models used and the size, nature, complexity and risk profile of the financial institution.

Consequently, the expectations in this guideline do not cover the full spectrum of models that a financial institution uses. A model's complexity and its materiality in the financial institution's operations are key considerations for sound and prudent model risk management. For example, the inappropriate use of more complex or material models or their results could compromise the financial institution's operations and result in adverse consequences for consumers. Financial institutions should pay particular attention to these models throughout their lifecycle.

Through this guideline, the AMF's intent is to ensure that:

- financial institutions have the necessary framework to manage their models adequately at each stage of their lifecycle;
- model risks are managed proportionally to the financial institution's model risk profile, complexity and size;
- models are well understood and associated risks are managed through a well-defined enterprise-wide model risk management framework.

Under the AMF's enabling powers,<sup>1</sup> this guideline applies to authorized insurers, financial services cooperatives, authorized trust companies and other authorized deposit institutions.

## 2. Terms, concepts and roles

The purpose of this section is to define the key model risk-related terms and roles that are essential for a financial institution. The first section covers the terminology relating to model risk and the second defines the main key roles.

### 2.1 Terms used

**Model risk management (MRM) framework:** Financial institution's framework for model risk management, including governance, key controls and oversight. MRM frameworks, which are supported by robust model lifecycle management, facilitate sound decision-making within a financial institution.

**Model risk rating:** Assessment of the level of model risk that considers various quantitative and qualitative criteria and the potential impacts of model outcomes on the financial institution. The model risk rating is an element central to all phases of a model's lifecycle. As a general rule, the work required to mitigate model risk should increase with a model's risk rating.

**Model lifecycle:** The subset of stages defining the life of a model, from identification of the rationale for modeling to decommissioning.

**Model:** Formalized representation of a concept, process or system that uses statistical, financial, economic, mathematical or other concepts to understand and predict the concept's, process's or system's behaviour. A model may also include sub-models, which should be considered an integral part of the primary model in the model's lifecycle. The level of effort to select, test, validate, document and monitor a model should take the model's risk rating into account.

**Modeling:** Application of theoretical, empirical, judgmental assumptions or statistical techniques, which processes input data to generate results. Modeling generally involves the following interrelated processes:

- building the theoretical model, including conceptualization, definition of the general principles of the model and specification of eligible risk factors;
- data input component that may also include relevant assumptions;
- data processing component that identifies relationship between inputs;
- model calibration;
- result component that presents outcomes in a format that is useful and meaningful to the financial institution's business lines and control functions.

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<sup>1</sup> *Insurers Act*, CQLR, c. A-32.1, ss. 43 and 464, *Act respecting financial services cooperatives*, CQLR, c. C-67.3, ss. 5.1 and 6, *Deposit Institutions and Deposit Protection Act*, CQLR, c. I-13.2.2, ss. 42.2 and 42.3, *Trust Companies and Savings Companies Act*, CQLR, c. S-29.02, ss. 254 and 255.

**Model risk:** Arises from flaws or limitations in the design, development, implementation and/or use of a model. Model risk management is inherent to the effective use of a model to limit adverse financial consequences (e.g., adverse effect on capital, financial losses, inadequate liquidity) or operational consequences (e.g., losses arising from deficiencies and failures attributable to human and material resources, such as procedures and internal systems) for the financial institution and potential reputational consequences. This risk relates less to the outcomes of the model than to the inferences, opinions and decisions arising from the model. Model risk can originate from, among other things, inappropriate specification, incorrect parameter estimates, flawed hypotheses and/or assumptions, mathematical computation errors, inappropriate or incomplete data, improper or unintended model usage, or inadequate controls.

## 2.2 Key roles

**Model approver:** Individual or team responsible for assessing the model validation team's findings and recommendations. The model approver should also validate the use or limitation of use of any new model or any changes to an existing model.

**Model developer:** Individual or team responsible for designing, developing and evaluating models and their methodologies. The developer may also perform ongoing monitoring and outcomes analysis, as well as periodic reassessment once a model is in use. For purposes of this guideline, the terms "model developer" and "development team" are used interchangeably. Depending on the importance of the issues reported by the model validation team and the validation team's findings, the model developer should apply the recommendations prior to the model's release.

**Model validation team:** Team responsible for validating the model and reporting its findings and recommendations to the model approver. The model validation team's other responsibilities, as part of the validation process, might include providing the model developer and user with guidance on the appropriateness of models for defined purposes and assessing model monitoring results. The model validation team may also act as the model approver, provided there is no real or potential conflict of interest and independence from the model owner, developer and user is maintained.

**Model stakeholder:** Individual or team impacted by the output of the model. Model stakeholders may include the ones mentioned in this section 2.2., but also others, such as the legal team and the compliance function.

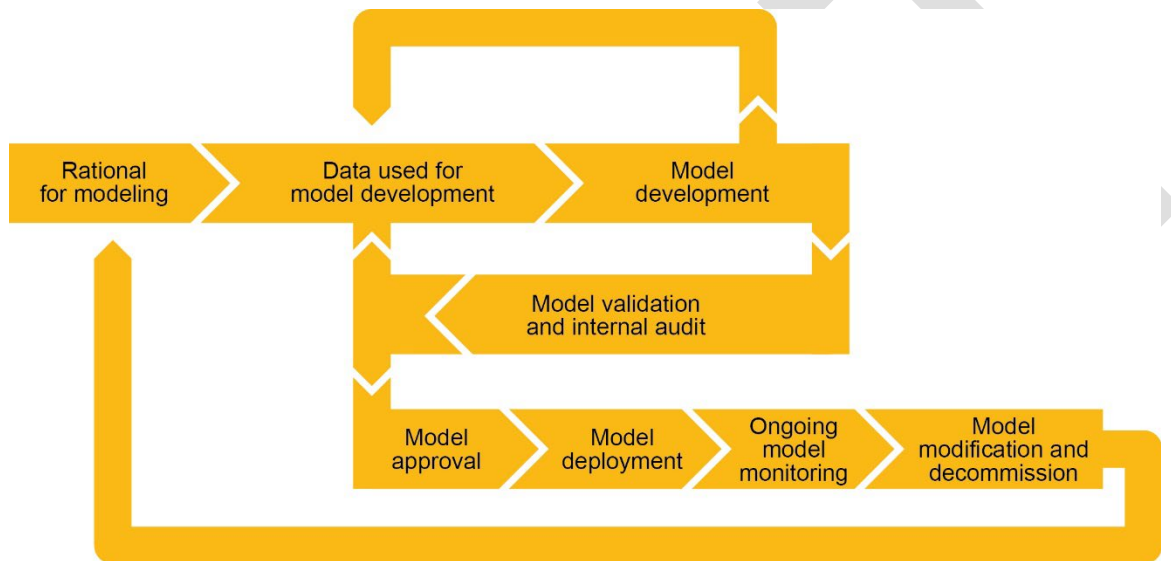
**Model owner:** Individual or team responsible for selecting the model to be used and for coordinating model development, implementation and deployment. The model owner is also responsible for ongoing monitoring and maintaining the model's administration, such as, where applicable, its documentation and reporting. The model owner may also be the model developer or user.

**Model user:** Individual or team that relies on the model's outputs to inform business decisions. The model user should be involved in the early stages of model development and in ongoing monitoring activities.

### 3. Model lifecycle

The AMF expects the financial institution to develop, document, approve and implement processes and controls for each stage of the model lifecycle, commensurate with the complexity of the model.

Typically, and by way of example, a model's lifecycle can be represented as follows:



At each stage of the model lifecycle, the financial institution should ensure that processes and controls are proportionate to the complexity of the model, the intensity of its use, its risk rating and the size of the financial institution.

For newly developed models, where a risk rating is not yet assigned, processes and controls relating to a model's lifecycle should, for example, be applied by the financial institution on the basis of a provisional rating, which should be determined while applying conservatism. The financial institution may also identify unique processes and controls by model type.

The financial institution should also ensure that documentation supporting the model lifecycle is current, maintained for each phase of the model's lifecycle and commensurate with the risks of the model.

The financial institution should prepare more comprehensive documentation for models that use, among other things:

- modelling techniques that are more complicated or based on significant assumptions,
- extensive use of expert judgement,
- large capital impacts and/or
- large customer impacts.

Where the model makes extensive use of expert judgement, the financial institution should document the results of the work, the inputs used by the expert and how the model responds after the involvement of the expert.

Lastly, the financial institution should ensure that all stakeholders involved in developing or modifying a model have the necessary knowledge and experience in the area concerned, based on their role and level of involvement.

### **3.1 Rationale for modelling**

Prior to the development of a new model, the model owner should identify a rationale for modelling that clearly articulates the model's underlying purpose, the scope of its coverage and how its outputs or outcomes will be used. For pre-existing and previously approved models subject to modifications, the model owner's rationale should address the reason for the changes.

The model owner should also ensure that all stakeholders of the model are identified. The decision to proceed to the next step of the model lifecycle should include input from relevant stakeholders, particularly noting qualitative and quantitative criteria that inform the model development process, as appropriate.

### **3.2 Data leveraged for model development**

The financial institution should ensure that the data leveraged for model development has the following properties:

- free from material errors, fit-for-use, all potential biases understood and managed
- reflect the intended target of the model
- adequately complete for the purpose of achieving the expected outcomes
- traceable (lineage and provenance) and well documented
- accurately recorded, with clear explanations
- timely, updated at a frequency aligned with its intended use

The presence of data quality issues could be potentially amplified when unstructured data is used. Where synthetic data elements are used along with empirical data for model development, the financial institution should have controls to delineate such data and should conduct appropriate assessments to ensure that the data meets the above properties.

For models addressing risks related to the business model, the financial institution should limit the use of external data from, in particular, another financial institution given the general lack of comparability between financial institutions with respect to this type of risk. In addition, the financial institution should ensure that:

- the data used are acquired mainly from an internal source

- the data are obtained in cooperation with the relevant business area experts (including data from the first line of defence<sup>2</sup>) and risk experts
- such data reflect the vulnerabilities in and maturity of the control environment

### 3.3 Model development

The financial institution should have development processes for model owners and stakeholders to follow. The model validation team should, however, vet the work of the development team to ensure that it has been performed properly. The intent should be to implement a model that can accurately assess the desired measures and report them back to the model users. Given that the development process is generally a first line of defence activity for model risk, it should comprise the following activities:

- identify suitable data, develop critical assumptions and quantify key parameters (calibration);
- cleanse the data;
- develop a robust methodology to arrive at desired outputs;
- identify appropriate performance measures to assess the model's quality, including defining acceptable performance boundaries;
- develop the code for the model;
- assess the stability of outputs from small changes in input values (model robustness) in relation to changes in model risk drivers;
- understand and communicate model outcomes and how they will be achieved; and
- develop a format for model outputs so that model users can effectively make sound decisions and model owners can monitor ongoing model performance.

The model development team should also ensure model transparency, meaning the ability of third parties, such as the financial institution's external auditors or the bodies supervising the institution, to observe and understand the model's objectives.

The model development team should work closely with other functions, such as risk management and internal audit, to ensure that the model is aligned with the financial institution's objectives and with existing regulations.

Furthermore, the model development team should use best practices in the market and verify the predictive properties, if any, and stability of the model. It should also perform activities such as benchmarking and back-testing.

A dynamic model calibration is a model that can automatically adjust its own parameters or behaviour in a production environment. As the prevalence of these adjustments increases, the financial institution should identify when a model recalibration event has occurred.

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<sup>2</sup> AUTORITÉ DES MARCHÉS FINANCIERS, *Governance Guideline*, April 2012.



### 3.3.1 Documentation and communication

Documentation is a necessary ingredient in the model development process. It aids understanding and implementation of the model and increases model risk management process transparency for reviewers. It also facilitates the preservation of knowledge at the institution as model users and owners change over time and if future iterations of the model are developed.

The model documentation should be updated as required and, at a minimum, contain the following information:

- a description of the model's general operation;
- a description of the data used for the calculations and their source;
- a description of the random number generator (if relevant);
- a description and justification of assumptions and use of professional or expert judgment;
- mathematical descriptions and references used (scientific papers, books, etc.);
- a description of algorithms used;
- approximations and simplifications used;
- the weaknesses and limitations of the model;
- circumstances under which the model does not function effectively; and
- details of the technologies and software used.

The financial institution should apply the above activities to models that rely on expert judgment<sup>3</sup> to inform key components of model development. The financial institution should document and analyze expert perspectives, how a consensus was developed, the data used before and after the involvement of experts, the outputs obtained and the applicability of data indicators. Also, the documentation should enable a third party to independently reproduce the model's outputs.

Model developers should maintain clear and regular communications with stakeholders, including by providing reports on model performance and any corrective actions that are taken.

## 3.4 Model validation and internal audit

### 3.4.1 Model validation

Model validation by means of independent review is a critical component of the model lifecycle. An effective validation process should enable the identification of potential model weaknesses and limitations and the determination of, and recommendation of measures to promptly address, sources of model risk. The validation process should focus on model

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<sup>3</sup> These models are unconventional models where components have been added to more closely replicate a real-life situation.

design outputs, whether developed in house or by external parties. The ultimate purpose of validation is to ensure that models remain fit-for-purpose.

To achieve this, the financial institution should use the work internal objective reviewers or third-party expert resources with the necessary knowledge and experience. The model validation system and process should be thoroughly documented. In particular, the financial institution should document the validation procedures applied, any changes to the validation methodology and tools, the range of data used, the validation results and any corrective actions taken. This documentation should be reviewed and updated regularly.

Model validation should take place independently of model development and ensure that models are conceptually sound, appropriate for their intended purpose and understandable to relevant model stakeholders. Model validation activities should occur at various points during a model's lifecycle, including:

- development and implementation stages of a new model;<sup>4</sup>
- when models are modified in response to monitoring outcomes;
- in response to other internal requirements (e.g., inclusion of new data);
- when performing sensitivity analyses of risks, both on an individual and aggregate basis, if applicable;
- when validating the consistency between implementation applications and the theoretical model;
- when identifying any known limitations of the day-to-day validation process, if applicable. If such limitations are identified, the validation team should document them;
- when documenting model components not considered in the validation;
- when confirming that validity back-testing and benchmarking to competing models were adequately performed, both at the aggregate risk level and for each risk component;
- when performing goodness-of-fit tests, particularly in the tails of distribution, if applicable;
- periodically, to review model performance or affirm, when necessary, that the model remains fit-for-purpose.<sup>5</sup>

In consideration of a model's purpose, risk rating and position within its lifecycle, validation should consider some or all the following activities:

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<sup>4</sup> Validation should demonstrate that the underlying theory of the model is conceptually sound, recognized and generally accepted for its intended purpose. From a forward-looking perspective, validation should also assess the extent to which the model, at the overall model and individual risk factor levels, can take into consideration changes in the economic or credit environment, as well as changes in portfolio business profile or strategy, without significantly reducing model robustness.

<sup>5</sup> The financial institution should have internally established standards for acceptable model performance. Where performance thresholds are significantly breached, corrective measures to the extent of model re-development or re-calibration should be considered.

- evaluation of model inputs<sup>6</sup>
- evaluation of the purpose, scope and use of the model output
- evaluation of the quality and relevance of the data used in the model
- assessment of the model risk rating, conceptual soundness, model limitations and corresponding mitigants
- assessment of the explanation provided for how a model produces outcomes
- assessment of the quality of model outcomes, model performance and monitoring
- assessment of back-testing and benchmarking to best practices in the market
- verification that supporting documentation for the model is complete

Financial institutions that use third-party libraries, platforms or automated development processes should be subject to independent validation commensurate with the potential risks these elements present.

The findings and outcomes of model validation should be reported in a prompt and timely manner to the appropriate level of authority.

### 3.4.2 Internal audit

Internal audit should ensure the adequacy of processes and controls with respect to:

- data maintenance. “Data maintenance” refers to the main components of the data management cycle: collection, processing, access, extraction, preservation and storage;
- consistency between financial statement items and model outcomes;
- the quality and performance of the technology infrastructure;
- model documentation;
- the work of the validation team;
- disclosure of issues and the escalation process to senior management and the board of directors, as appropriate;
- identification of the resources authorized to make changes to the model.

Internal audit should also ensure that model users:

- have the necessary authorizations to use the model;
- have the skills and experience to use the model;
- understand model risk and the limitations of the model;
- know the financial institution’s levels of risk tolerance and limits;

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<sup>6</sup> The financial institution should have internal data quality and reliability standards (historical, current and forward-looking) to be used as inputs for the model. Where required, these internal standards should be aligned with the standards established by the AMF.

- do not fail to provide material information affecting decision-making processes by ensuring that there are processes and controls in place for that purpose;
- synthesize all relevant information so that senior management can understand the financial institution's day-to-day exposure to the various risks considered by the model;
- can explain all model outcomes; and
- obtain the necessary authorizations in advance of making any changes to the model or its inputs.

Where required, internal audit should make sure the financial institution satisfies the use test requirements. The use test is a process used to ensure that appropriate use is made of the rating system to manage credit risk. The use test should be applied on a financial institution-wide and continuous basis. This test should be viewed as a complement to governance principles. Internal audit may, at its discretion, also perform certain technical validations.

### 3.5 Model approval

Model approval typically involves two components: assessing whether the model is suitable to be implemented into production based on its intended use and affirming the assigned model risk rating.

Approval requirements<sup>7</sup> should apply throughout the model's lifecycle, including for anything relating to model modifications and periodic reviews.

The financial institution should ensure that model validation occurs prior to approval and deployment, particularly for models used for regulatory capital inputs or internal risk assessment and control. The model developer and model validation team should be primarily responsible for providing to the model approver the outcomes or their review, along with their recommendations.

A model may be approved despite identified weaknesses or limitations provided that a margin of conservatism is applied and appropriate and reasonable compensating mitigants are in place, or if the stakeholder group provides justification for using a model in such circumstances. However, conservatism in assumptions should not be a substitute for fundamental analysis and should be balanced against model accuracy.

For instance, pricing and provisioning models should mainly prioritize accuracy. Financial institutions should have policies that articulate their use of conservatism in model assumptions and, where appropriate, overlays on model outputs. Prior to model approval, the financial institution should address major model weaknesses or apply a margin of conservatism. By way of illustration, an example of such a weakness would be a model failing to achieve an acceptable performance based on relevant and defined metrics.

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<sup>7</sup> This applies in the case of both model approvals by the financial institution's internal teams and approvals obtained from the AMF.

### **3.6 Model deployment**

Generally, the deployment process is a collaborative effort among model developers, model owners and model users, who should also collaborate with strategic and operations partners responsible for managing staging and production environments.

Prior to model deployment, the financial institution should ensure that the model outputs can be replicated in the production environment. It should also test the functionality and robustness of the production environment and the associated infrastructure. Depending on the nature of the deployment (e.g., new model versus modification), this may include system integration and/or user acceptance tests.

Consistency between data used to develop the model and the production dataset should also be confirmed prior to the model's release. The financial institution should develop contingent actions for situations where the model is unavailable for periods of time, there is significant deterioration in its predictive properties or the model fails.

The financial institution should exercise adequate oversight over models obtained from third parties, if any, including consideration of the third party's development environment and model architecture.

### **3.7 Ongoing model monitoring**

Once a model is deployed, it should be subject to monitoring and periodic validation that is commensurate with its assigned model risk rating. Monitoring intensity should also depend on characteristics of the model. Model owners should be responsible for conducting ongoing monitoring and gathering input from stakeholders, as appropriate, including from the model development team. Where third-party vendors are involved, model owners should ensure the products acquired have adequate controls.

Monitoring results should be shared with model users in a timely manner and reflected in the model's risk rating. Unsatisfactory results arising from monitoring should be subject to an escalation process whereby appropriate stakeholders are notified, including downstream parties impacted by the model. Unsatisfactory results should prompt a remediation plan. Depending on the nature of the deficiency, the remediation plan may include application of a judgemental overlay, acceleration of model modification timelines, granting a temporary exception or placing restrictions on model usage. Modifications initiated to remediate performance deficiencies should be subject to model validation and approval requirements.

### 3.8 Modifications and decommissions

The modification process should reflect the iterative nature of the model lifecycle whereby models may undergo several rounds of revision before being decommissioned. Specifically, modifications may include the inclusion of more recent data, the introduction of a new data source, a change in the technology or infrastructure used to supply the data or determine outputs, a change in the underlying methodology or a change in the model's operating environment.

Informed by model risk ratings and the potential impacts of the changes, financial institutions should segregate modifications into different classes of importance and scale the redevelopment, revalidation and reapproval activities that will be necessary, as applicable. In addition, financial institutions should conduct follow-up between changes that aligns with approval follow-up to prevent a divergence between the most recently approved model version and the one used in production. A history of the follow-up performed should be kept for a reasonable period and be available for reference, if necessary.

Financial institutions should also maintain a catalogue of material changes to the model, including to the model calibration, and define thresholds for what signals a material modification. When a modification threshold is breached, the financial institution should re-evaluate the model to determine if it remains fit-for-purpose under the criteria of its most recent approval.

When a decision is made to decommission a model, the model owner should notify the relevant stakeholders, including the model owners and users, about the upcoming decommission. The decommissioning of a model does not necessarily represent the end of its lifecycle. A decommissioned model could act as a benchmark or might need to be recommissioned if the new model fails to be implemented properly or perform up to minimum risk tolerances. For business continuity purposes, the financial institution should, depending on the type and importance of the model, maintain the decommissioned model for a reasonable period of time.

The financial institution should be promptly made aware of modifications to and decommissions of any internally developed or third-party models and mitigate against potential impacts based on the importance of the model. Changes made to a third-party model should comply with the same minimum requirements as internally developed models. Financial institutions should also develop contingency plans for any model with higher risk ratings in the event that third-party vendor support is deemed inadequate or were to cease altogether. The AMF may ask the financial institution to demonstrate that the established contingency plans are appropriate and sufficient.

## 4. Model risk management framework

**The AMF expects the financial institution to establish a model risk management framework that provides a view of its exposure to model risk.**

The model risk management (MRM) framework is the foundation of a model's lifecycle. The MRM framework should reflect the financial institution's risk appetite and define the process and requirements to appropriately identify, assess, quantify, control, mitigate and monitor risk throughout the lifecycle of the models employed across the financial institution.

The financial institution should regularly review and update its MRM framework to ensure it remains relevant and appropriate. To this end, the financial institution should make continuous improvements to the framework considering insights and lessons learned from the validation team or users.

### 4.1 Model inventory

**The AMF expects the financial institution to maintain a centralized inventory of all important models in use and recently decommissioned. This model inventory should be considered the authoritative record of all such models and should be updated regularly and subject to robust controls.**

The financial institution should be to identify, understand and track the performance, risks and limitations associated with each model in the inventory and be able to affirm that a model is used for its original purpose.

The model inventory should serve as the basis for management reporting. Updates to the inventory should be made in a timely and diligent manner, including changes to reflect modifications to models, their risk classification or updates to model performance. The financial institution should also implement risk-based controls to confirm the accuracy of its model inventory. The financial institution should have a list of individuals that have the authority to control and maintain the model inventory. The model inventory should, at a minimum, maintain the following for each model:

- Model ID
- Model version
- Model name and description of key features
- Model risk classification
- Identification of model stakeholders (e.g., owner, developer, etc.)
- Date of model's most recent validation
- Exception status
- Performance rating resulting from ongoing monitoring
- Model dependency (instances when the outcome of the model is an input into another model)

- Date of model's deployment into production
- Approved use of the model
- Model limitations
- Next model review date
- Model origin and type of development (e.g., internally developed, vendor)
- Performance monitoring frequency
- Model risk rating
- Validation findings

#### 4.2 Governance and accountability for models and data

**The AMF expects the financial institution to have policies, procedures and good governance practices for each phase of the model lifecycle and for those policies, procedures and good governance practices to be established based on model complexity and importance.**

The financial institution should ensure that the model developer and validation team are skilled in the quantitative methods and techniques required to conduct a model review, including sufficient knowledge of the business area for which the model is being used.

To support an effective MRM framework, the financial institution's policies should define exceptions and establish thresholds that are aligned with the financial institution's risk appetite. In defining exceptions, the financial institution should recognize the integrated nature of the model lifecycle (for example, if a model does not adhere to requirements of the development policy) and provide for appropriate classification internally. For the AMF, exceptions include: a model is used outside its intended purpose, a model displays persistent breach of performance metrics; or a model is overdue for its scheduled revalidation.

The financial institution may obtain models or data from third parties. Where the financial institution acquires a model or data from an external source, such models or data should be governed by an MRM framework and be subject to the same requirements and controls as internal models. The financial institution retains ultimate accountability for outsourced activities and should secure adequate documentation from providers to understand the model's design, calibration and operation consistent with internally developed models.<sup>8</sup>

An exception policy should provide for consistent identification and notification of appropriate stakeholders. These policies should be approved for all model types. They should also detail circumstances that merit the removal of the model and imposing conditions that could limit model usage. In granting an exception, the model approver should have the power to impose restrictions on the model's usage.

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<sup>8</sup> AUTORITÉ DES MARCHÉS FINANCIERS, *Outsourcing Risk Management Guideline*, April 2009.



**The AMF expects the financial institution to recognize the interdependency between data and model risk and have adequate policies and procedures to govern the data used in models. These policies and procedures should align with the financial institution's data governance framework and strategy.**

A financial institution's data governance policies and procedures should be integrated with and leverage, where possible, data governance and management requirements established at the organizational level. Furthermore, these policies and procedures should provide a consistent approach to understanding and managing vulnerabilities, challenges and changes to the data, including bias, fairness, privacy and other relevant considerations, particularly with respect to artificial intelligence and machine learning techniques.

### **4.3 Model risk assessment and reporting**

**The AMF expects the financial institution to have appropriate controls to facilitate the transparent and consistent monitoring of model risk at the organization level.**

The financial institution should periodically report the following to model owners, users, the validation team and senior management:

- types of models in use at the financial institution;
- performance of individual models over their model lifecycle;
- description of the operating environment in which models are used;
- exceptions from the organization's MRM framework;
- organization-level assessment of model risk.

### **4.4 Model risk rating**

**The AMF expects the financial institution's model risk rating scheme to consider both qualitative and quantitative criteria, as well as potential impacts on downstream processes.**

Under the MRM framework, the financial institution should implement an appropriate model risk rating scheme applicable to all models. It should be designed to allow for consistent application across model types and should facilitate the identification, assessment and management of model risk at the organization level. It should also allow for regular reporting of model risk.

In devising the model risk rating scheme, the financial institution should consider model risk using quantitative and qualitative criteria. The application of the model lifecycle requirements should be commensurate with a model's risk rating. This means the model risk rating may drive the level of authority required to approve the model, the frequency

and scope of model monitoring and independent review and the interval at which the risk rating is re-assessed.

Specifically, with respect to financial impacts, quantitative factors may include, for example, considerations such as the importance, size and growth of the portfolio that the model covers, capital effects or potential customer impacts. Qualitative factors may include considerations that increase uncertainty such as level of use, complexity of statistical approaches applied, reliability of inputs and conclusions from the model review process.

The AMF also expects model risk ratings to be reviewed regularly, including when a trigger event occurs and makes a model update necessary. Examples of trigger events include: a change in the underlying business environment, increases in the size or scope of a business line, unexpected deterioration in model performance or any material model modifications.

In cases where model risk ratings fall outside the financial institution's risk appetite, the financial institution should establish appropriate corrective measures. Examples of such measures include: modifying the model, increasing its monitoring frequency, increasing the frequency of its grading assessment or limiting its usage.

The AMF expects the models supplied to subsidiaries by the financial institution's parent company to be assessed for model risk ratings on a standalone basis. Each subsidiary should have access to technical documentation from its parent company to assess and manage the model's unique risk profile.

## **4.5 Roles and responsibilities assigned to the board of directors and senior management**

### **4.5.1 Roles and responsibilities of the board of directors**

In addition to the expectations set out in the *Governance Guideline*,<sup>9</sup> the AMF expects the board of directors to ensure that the financial institution has a model risk governance policy.

### **4.5.2 Roles and responsibilities of senior management**

The financial institution demonstrates transparency in the management of its activities by informing the board of directors and the AMF of situations with a material impact on models—situations that may, for example, result in solvency issues or reputational harm for the financial institution. In addition to the expectations set out in the *Governance Guideline*, the AMF expects senior management to:

- develop a model risk management policy that clearly defines the responsibilities of key roles, illustrating, for example, a clear separation between model development and validation;

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<sup>9</sup> AUTORITÉ DES MARCHÉS FINANCIERS, *Governance Guideline*, April 2021.

- include in the financial institution's risk management policies assignments for the development, implementation, continuous updating and application of practices designed to satisfy the requirements for use of the model;
- develop a reporting process to ensure that the findings and recommendations of the validation team<sup>10</sup> and internal audit are considered by the decision-making bodies<sup>11</sup>. In particular, the validation team and internal audit should both be given an opportunity, at least once a year, to present their observations to the board of directors;
- ensure that the activities of the model development, model validation and internal audit teams are not biased by any form of influence within the financial institution. Models must be developed, validated and internally audited by parties that will not profit, directly or indirectly, from the results arising therefrom;
- ensure that, despite staff movements, stakeholders have an adequate understanding of the model;
- follow up on model implementation effectiveness at least once a year;
- develop a business continuity plan in the event an issue arises with the model; and
- ensure that validation exercises are carried out on a recurrent basis (at least annually).

#### **4.6 Risk management function**

With respect to models, the responsibilities of the risk management function should be to:

- set up a model validation team that reports to it;
- define and implement a framework for model validation and the use of professional judgment that takes into account:
  - the business strategy; and
  - risk appetite, risk tolerance and limits and the metrics used;
- ensure that model risk sources are managed and model outputs are sufficiently reliable and stable to support decision-making; and
- make a recommendation as to whether the model should be used.

#### **4.7 Internal audit function**

The internal audit function should consider all the activities relating to the model and evaluate interactions with the financial institution's other activities. Its function, in connection with the model, should be permanent and separate from the risk management function. The internal audit function should have a clear mandate and sufficient and qualified resources.

The AMF expects internal audit to review the effectiveness of the internal controls that are intended to ensure adherence to the requirements for the use of the model. To this end,

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<sup>10</sup> The validation team should report to the chief risk officer.

<sup>11</sup> The decision-making bodies are defined in the AMF's *Governance Guideline*.

the financial institution must submit to the AMF, at the frequency determined by the AMF, a report by the auditor containing, at a minimum:

- a description of the scope of the audit of the models;
- an assessment of the operational effectiveness of the models.