

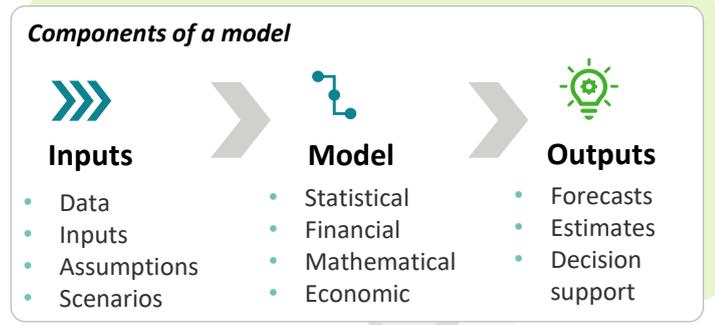
## Model Risk Management

Anticipate, Analyze and Avoid Risks

# Background

Fueled by growing technological advancements, regulator requirements and innovative product designs, banks and financial institutions (FIs) have been increasing the use of models in all critical aspects of the decision-making process. Deeply integrated in business processes, growing in scope and complexity, models have become the main source of quantitative, predictive data and information.

With the increased use of and dependence on complex models for underwriting, portfolio management or regulatory capital calculations, model risk is emerging as a prominent type of risk in its own right.



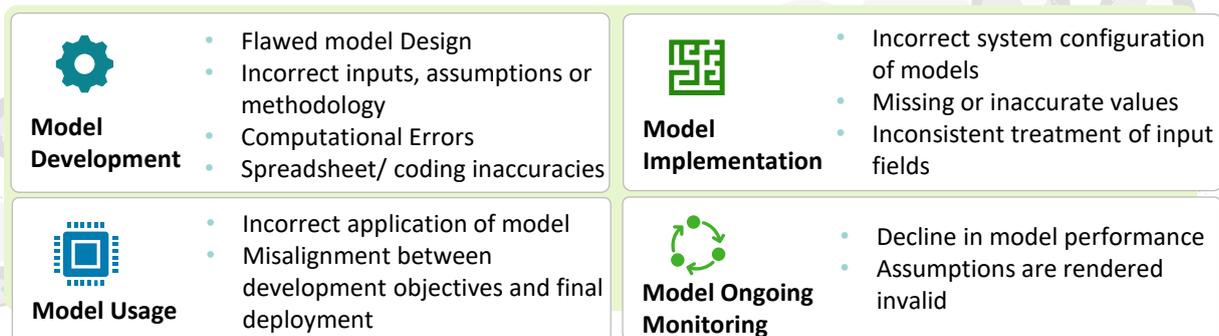
# Definition of model risk

The definition of a model and model risk varies across institutions and SR11-7 definition is often used as a starting point which states that, “a model refers to a quantitative method, system, or approach that applies statistical, economic, financial, or mathematical theories, techniques, and assumptions to process input data into quantitative estimates. Often models are interconnected between products or processes with estimates derived from one model being used as input in another”.

Model Risk can be defined as the potential loss an institution may incur, as a consequence of decisions that could be principally based on the output of (internal) models, due to errors in the development, implementation or use of such models. (CRD IV, Article 3.1.11)

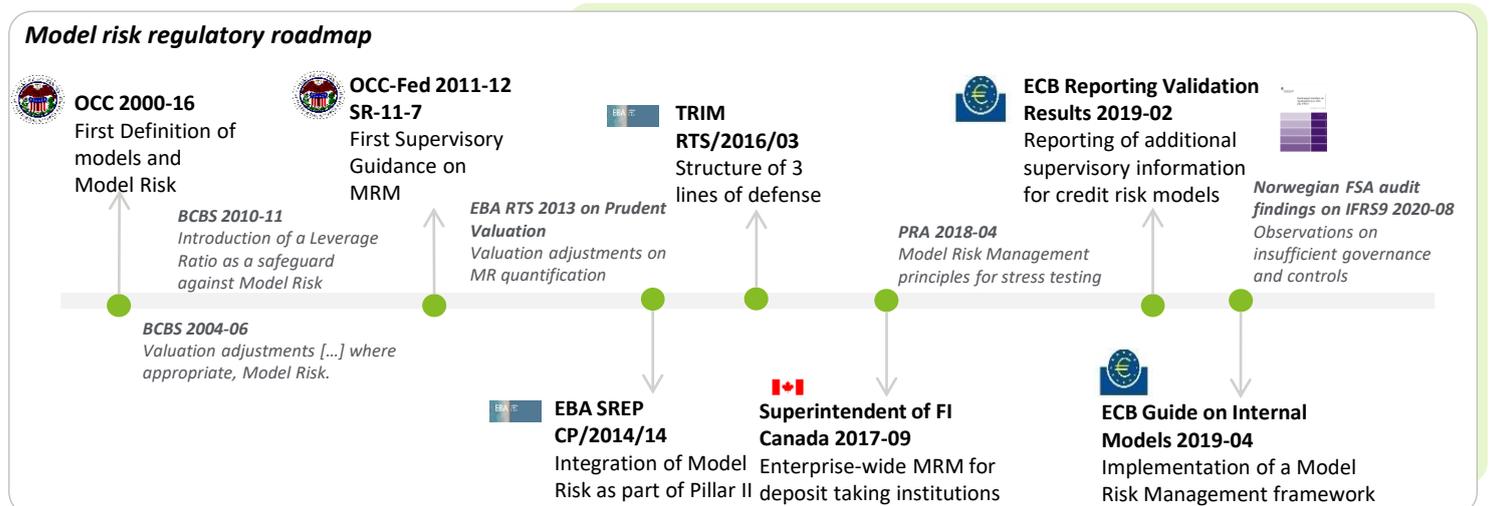
# Model risk stems across all phases of the model lifecycle

Various factors across the model lifecycle affect the model output, which informs management’s decision-making. While certain elements of model risk may be state driven (i.e., prevailing at a certain stage of the model lifecycle) – such as model initiation, development, implementation, usage, ongoing monitoring and decommissioning – the risk of model decay is ubiquitous, and may materialize at any point during a model’s existence.



# Model risk regulatory landscape

Regulators are responding to this incremental exposure through focused supervision in the field of model risk by implementing a regime capable of delivering effective oversight on Financial Institutions and their model risk mitigation and management measures.



# Model risk management

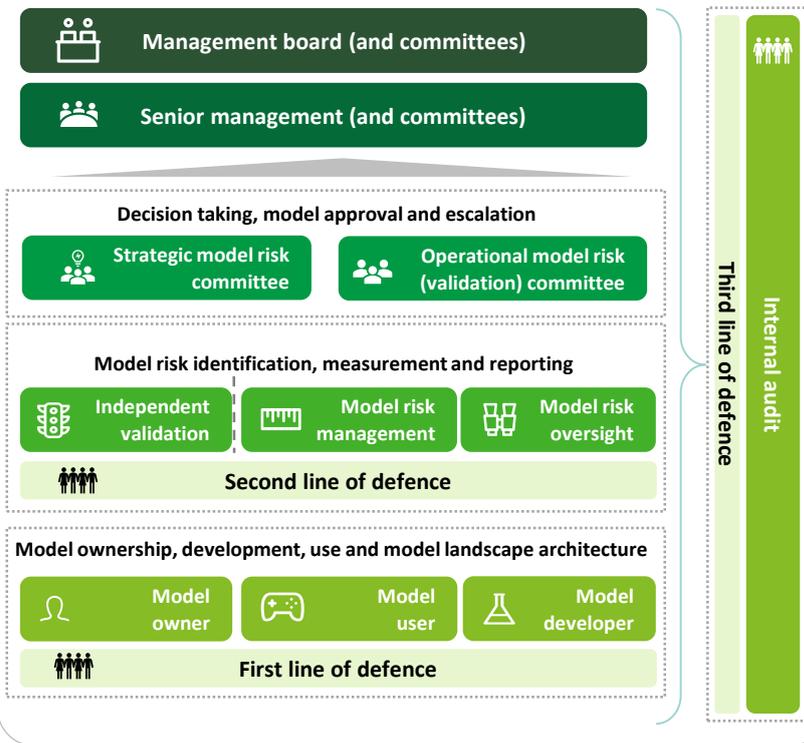
Although use of models by banks and financial institutions have brought objectivity in their decision making but it has also led to a significant increase in model risk. Mitigation of model risk requires effective and robust implementation of model risk management (MRM) framework that involves defining ownership, describing roles and responsibilities and enabling various stakeholders to work together in a synchronized manner.

Model risk management function acts as a key point of reference for all matters related to model risk and paves the way for setting up the guidelines on model development, validation, classification, monitoring, documentation, inventory and reporting.

Regardless of the size and complexity, 3 Line of Defence model has been identified as an effective way to manage and control the model risks within an organization, when actively supported and guided by the organization's governing body and senior management and enabled by a robust framework.



## Model risk management and governance framework



## Components of MRM framework

- Organization and Governance**  
MRM policy, roles and responsibilities, control framework and rationalization, strategic integration with model risk appetite, MRM monitoring, MRM risk awareness and mind-set.
- Model Control Framework**  
Validation procedures, separate and independent model development and validation teams, periodic coordination between MRM, development and validation processes, model prioritization
- Model Lifecycle Management**  
Model definition, model discovery, model inventory, model categorization, model documentation
- Model Risk Quantification**  
Quantitative techniques for model risk mitigation regarding data, estimates and uses.
- Model Risk Management Processes & Technology**  
Technology infrastructure and workflow management for integrating various processes in the MRM framework.

## Key challenges

- Gathering accurate and sufficient data. Incomplete, corrupt, erroneous or missing data decreases model performance/reliability and increases model risk
- Identifying models implemented across the front-line business and support functions and establishing controls across their life cycle including documentation
- Statistical challenges including uncertainties introduced by the chosen methodology or by invalid/ incomplete underlying assumptions
- Attracting and retaining specialized staff for development, and implementation of models within front business lines or support functions as well as trained staff to manage model risk and perform independent model validation
- Ensuring correct and complete development and implementation of models to avoid errors
- Complexity in model calibration resulting in errors from incorrect or inaccurate fitting of model parameters to data
- Articulating clear roles and responsibilities across model lifecycle between departments for managing model risk
- Determining model materiality i.e., significance of impact resulting from model error or mis-use in light of interconnectedness and multiple use of models
- Designing and implementing model risk appetite framework and limits

## Our solution

We offer end-to-end model risk management framework implementation from model planning, model development, model validation and on-going monitoring. We design customized MRM frameworks for our clients consisting of model risk governance and policy, model development and validation standards, model inventory/ tiering and model risk appetite to manage model risk across model lifecycle.

We support our clients in managing model risk through supporting front-line business units and support functions in model development and support the second line of defense in providing effective oversight and validation on models under their purview by performing independent validation or providing automated model monitoring solutions.

### Service Offerings

 <p><b>Model risk management framework</b></p>	<ul style="list-style-type: none"> <li>• We undertake assessment of current state of model risk management practices, either are to be developed or already implemented</li> <li>• We design and develop end-end-to model risk management framework including model risk governance framework including roles and responsibilities of the board, senior management, risk function, business units and support functions in managing model risk in the bank</li> <li>• We develop organization-wide model risk policy</li> <li>• We develop model validation policy including framework for model monitoring and validation, model development and validation documentation standards and model validation procedures including validation methodology and techniques for various types of models (statistical, expert judgement, vendor developed)</li> <li>• We develop a comprehensive framework for model inventory and assist in building current model inventory to identify and record models implemented, along with the model tiering</li> </ul>
 <p><b>Model development</b></p>	<ul style="list-style-type: none"> <li>• We develop models across various fields including credit risk, market risk and capital risk</li> <li>• We develop models for IFRS 9, Stress testing, Basel, ICAAP and ILAAP</li> <li>• We develop greenfield models for new products/ portfolio/ businesses as well as data driven models</li> <li>• We design scorecards, deterministic as well as probabilistic models</li> <li>• We develop standard operating procedures for model development</li> </ul>
 <p><b>Model validation</b></p>	<p>We undertake quantitative and qualitative independent model validation and testing across entire suite of models including but not limited to Basel models, IFRS-9 models, rating models and scorecards, PD, LGD and EAD models, VaR and stress testing models, pricing models and risk sensitivity computations as well as ICAAP including Pillar II risk models and economic capital computation models.</p>
 <p><b>Model on-going monitoring and automation</b></p>	<p>A customized, scalable and transparent automated tool that can enable banks and financial institutions to generate statistical metrics and reports at a desired frequency to manage model risk. The process includes:</p> <ul style="list-style-type: none"> <li>• Formulating appropriate statistical measures for each of the component and define metrics / thresholds</li> <li>• Identifying required data fields and sharing data request templates</li> <li>• Creation of SAS/ Python/R macros for each of the defined metric</li> <li>• Deployment of customized dashboards</li> </ul>
 <p><b>Training and capacity building</b></p>	<p>Given the specialized and dynamic nature of models and model risk, we offer awareness and targeted trainings to our client's front-line staff and risk managers to enable them to manage model risk across the organization in a holistic manner</p>

## Our operating model

We provide flexible delivery options best suited for our clients allowing them to make an informed choice on the operating model.

 <p><b>Project-Driven</b></p> <p>Deloitte onboard the Bank or Financial Institution's model validation project as a one-time service and establishes project timelines, project management framework and QAR processes to ensure quality delivery.</p>	 <p><b>Managed Service</b></p> <p>Deloitte to provide a team of model validation specialists for ongoing services to manage within a specified long-term period when required by the bank.</p>	 <p><b>Loan Staffing/ Secondment</b></p> <p>Deloitte offers qualified team members with the relevant expertise on secondment to conduct the model validation exercises within a pre-approved timeline, under the guidance of the bank.</p>
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# Our differentiators

We have assisted multiple banks and financial institutions in model development, validation and have designed and implemented MRM frameworks in the region and globally

We bring access to unequalled expertise and insights through our team who have worked with global and regional Banks, providing globally tried and tested methodologies boosting your time-to-value.

**Our success stories**



**Our subject matter experts**



**Our tools and accelerators**



**Our commitment**



At Deloitte we have a library of in-house proprietary tools and accelerators that we can leverage to deliver our services effectively and efficiently.

Given our unparalleled expertise and experience, we are committed to support in the entire journey and assist in the successful model risk management for the Organization



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