

**Model risk management at investment  
management organizations**

Navigating the risks associated with models

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Investment managers use models to create value for their organization, investors, and customers – but model usage can be a source of significant risk, including economic and financial losses, and tarnished reputations. How can organizations better manage the risks related to models?

# Models are pervasive. Do organizations understand the risks?

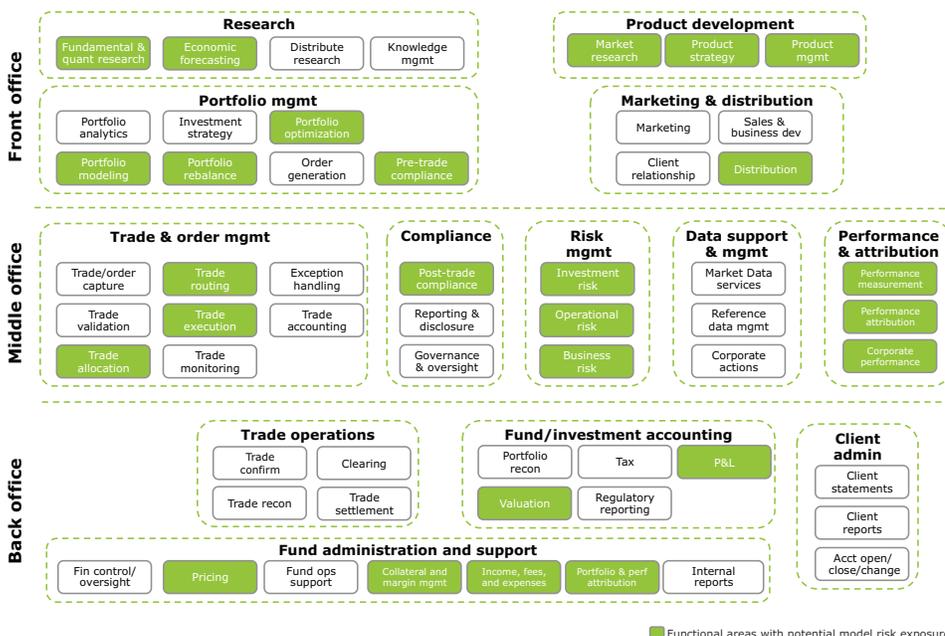
The investment management industry is currently undergoing a transformation to harness the power of process-driven analytics and human insight to solve complex problems, and drive strategic and day-to-day decision making. Indeed, in today's digital world, the use of process-driven analytics, such as models or complex algorithms, has grown out of necessity in order to consume and transform the plethora of data into inputs and decision facilitators. Where product, transaction, strategy, client, organizational and other data was once difficult and time consuming to analyze - advances in data analytics, artificial intelligence, advanced mathematical algorithms, and cognitive learning models are accelerating the transformation of data into inputs and indicators to make or facilitate investment, sales and distribution, risk management, operations, and strategic decisions.

The result is what you might expect. The rapid growth in model usage across the industry has caught the attention of regulators. In addition to a few high profile regulatory actions, regulators including FINRA and the SEC have also issued industry guidance – specifically related to the use of robo advice models.

Yet while many investment managers may be using models to facilitate investment advice, scores of other models may also be used across the business to formulate other decisions, including business and strategy, operations, and risk. Our experience suggests that many investment managers have struggled to identify and understand what models are being used across the enterprise, what decisions models are providing inputs to or facilitating (and in some cases making), how these models are being developed, and what controls exist to manage them.

Why this confusion? In part, it is because there is limited regulatory guidance for determining what a model is, and how to prioritize a model's importance to the organization. While much attention has been paid to investment models due to several recent control failures that have made headlines – as illustrated in figure 1, models are pervasive and exist across the enterprise. Stepping outside the investment office, we have observed models being used to facilitate ETF basket creation, trade aggregations and allocations, liquidity risk management, expense allocations, tax reclaims, and a host of other activities.

Figure 1. Models are everywhere.



## Model failures in the news

Several model issues have grabbed the attention of regulators, stakeholders, and investors. In one notable instance, a global investment manager delayed correcting a material error in its computer code that removed one of the key investment risk management components. The error adversely affected a significant number of client accounts resulting in investor losses of millions of dollars. The failure was the result of ineffective model risk management (MRM) infrastructure (i.e., people, process, technology, data, and governance) that could have detected the error sooner and mitigated investor losses.

In our experience, model issues have occurred because model elements (e.g., algorithmic formulas) are not properly maintained and updated when new data becomes available or when there is a modification to existing data, models are not documented such that they can be understood by users or stakeholders, assumptions are not tested adequately resulting in faulty data inputs and assumptions, or models are not validated. Regardless of the cause however, model issues and failures often cost millions of dollars to investigate and remediate – causing significant erosion in organizational value, including reputational loss, regulatory sanctions, and economic and financial losses.

The good news for investment managers is that the benefits for establishing a program to manage the risk exposures created by

models far outweigh the potential risks and associated costs resulting from model issues or failures.

This paper introduces leading practices in managing the related risks through the design and implementation of an MRM framework that can be applied consistently throughout the organization.

**Defining model risk and MRM for investment managers**

When defining what a model is, many investment managers may want to consider starting with the definition of a model that is used by banking and securities regulators, and then tailor that definition to fit their unique business needs and more closely align with model usage within their organization.

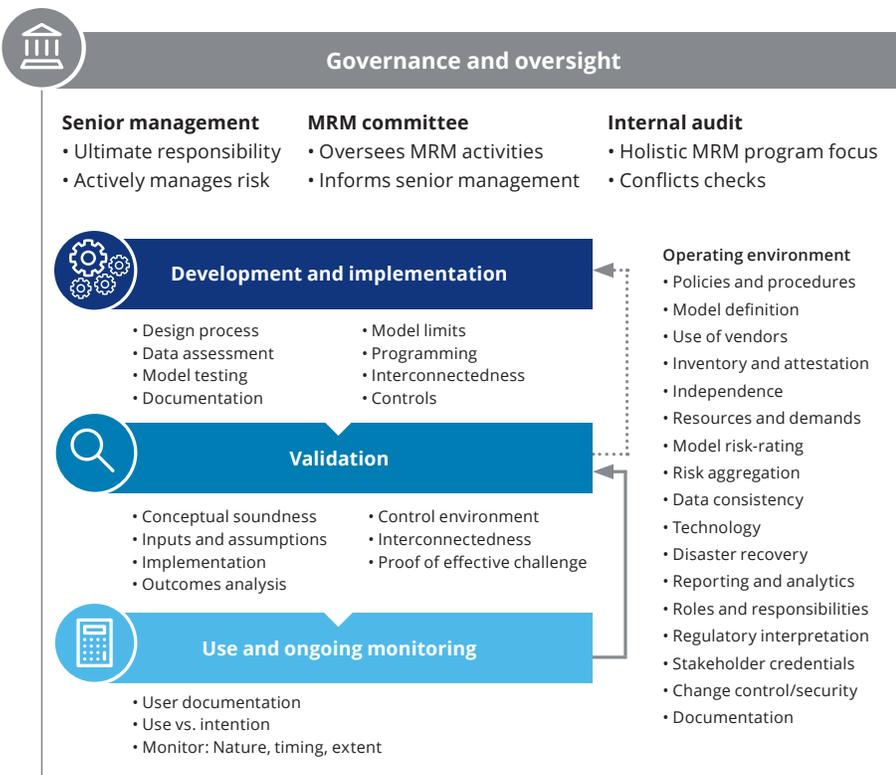
Within this context, “model risk” is the risk of monetary loss, harm to clients, erroneous

financial statements, improper investment or managerial decisions, or damaged reputation resulting from poorly built, used, or controlled models.

To mitigate the potential adverse impact of the model use environment, MRM is a discipline of risk management that provides a structured approach across the model life cycle. MRM helps to define the shared roles, responsibilities, and accountabilities (inclusive of decision rights) across the three lines of defense and facilitates the development of an effective control environment, including policies, procedures, and corollary controls.

As illustrated in figure 2, a well-defined MRM framework integrates these roles, responsibilities, and control activities and can be used to effectively mitigate the adverse risks associated with model failure.

Figure 2.



There is not an industry-wide definition of what a “model” is, but banking and securities regulators define a model as being “a quantitative method, system, or approach that applies statistical, economic, financial, or mathematical theories, techniques, and assumptions to process input data into quantitative estimates.”

### Establishing a MRM framework

Establishing a MRM framework and program can seem challenging at first. Given the potential for wide-spread model usage and risk exposures across the enterprise, some organizations may ponder the need to create a centralized function and hire dedicated resources to manage model risk. Depending on your organization's model use environment, a central function with dedicated resources may not be right sized for your organization. Often times, MRM starts by establishing program governance, including adopting model policies and standards related to model usage,

documentation and change management, and delineating roles, responsibilities and accountabilities for model development, testing, and maintenance.

In our experience, many investment managers already exhibit some of the basic, foundational elements of MRM. As a starting point, investment managers should first identify and analyze their current MRM practices to identify enhancement opportunities and where they need to expand their efforts to capture all of the relevant models used throughout their business.

### Spotlight on emerging practices: Intersection of MRM and liquidity risk management

Among other requirements, Rule 22e-4 (the Liquidity Rule) of the Investment Company Act of 1940 requires fund managers to (1) classify securities into liquidity buckets (i.e., highly liquid, moderately liquid, less liquid, and illiquid), (2) establish a highly liquid investment minimum for funds that do not qualify as investing primarily in highly liquid investments, (3) annually assess the effectiveness of implementation and operation of the liquidity risk program, and (4) for ETFs, consider the relationship between the ETF's liquidity and the efficiency of the arbitrage function. Based on our experience, many fund managers are developing the infrastructure to develop, validate, and memorialize the models and complex methodologies used to facilitate these liquidity risk management requirements. In addition, many fund managers have also developed policies and procedures to periodically evaluate the ongoing efficacy of these models.



# The MRM operating environment and governance and oversight

## MRM operating environment

There are several pillars of the MRM operating environment that investment managers should consider when establishing their MRM frameworks:

- Inventory and risk rating: Maintaining a complete and accurate catalog of models, risk-rated by their qualitative and quantitative factors and the decisions that they facilitate, is at the heart of a sound MRM framework.
- Policies and procedures: Detailed guidance that governs the standardized roles, responsibilities, and activities for each stage of the model life cycle, and drives cadence and consistency in facilitating MRM. These protocols should be tailored to the investment manager's risk appetite and the degree of reliance on model-enabled processes and decisions.

As illustrated in figure 2, there are other elements of the operating environment that are designed to improve the sophistication and effectiveness of the MRM framework.

## Governance and oversight

It is important to manage model risk through active ownership by the senior-most levels of the organization.

While MRM is a shared responsibility by stakeholders throughout the organization, a dedicated functional area can serve as the centralized linchpin between senior management's oversight and the day-to-day mandate of MRM policies and procedures.

For investment managers, the risk function and chief risk officer, may be in the best position to play this role. However, depending on organizational structure and skill-set requirements, the chief operating officer, chief investment officer, or chief information officer channels could also effectively drive MRM.

Many organizations that have implemented a MRM program have aligned roles and responsibilities consistent with the three lines of defense structure common throughout the industry. In this structure, model developers or owners perform first line of defense procedures related to model development, implementation, use, and monitoring. Model validation is performed by a second line of defense function and internal audit plays a distinct role as the third line of defense by ensuring that a comprehensive MRM program has been designed and implemented effectively, and that, where applicable, segregation of MRM responsibilities exist.

## Model development and implementation

A sound MRM framework includes defined activities for model development and implementation. This includes procedures for designing and testing the model's underpinning theory, performance, and related inputs and assumptions, as well as documenting these considerations in a uniform manner.

Investment managers may internally develop or purchase models from a vendor. Therefore, well-defined procedures should indicate the due diligence activities expected for both scenarios.

## Model validation

Model validation is among the most critical activities in the MRM framework. In this stage of the model lifecycle, an individual, other than the model developer initially, and periodically thereafter, performs a series of checks and analyses to confirm that the developer adhered to the internal development standards, as well as to determine the model's continued fitness for use.

The nature, timing, and extent of validation activities is determined by the risk-rating methodology.

## Use and ongoing monitoring

Continued monitoring of model performance by model owners (developers and/or users) can help identify potential model calibration and/or use issues in between scheduled model calibrations and validations.



# Investment management MRM framework considerations

MRM programs will be different for each investment manager – based largely on their model use environment.

As illustrated in figure 3, the level of effort and related cost, as well as the degree of regulatory and stakeholder focus, will depend on the riskiness of the investment manager’s models, model-use environment, and the regulatory environment.

There is no “one size fits all” MRM framework. Investment managers that are interested in standing up an MRM framework should include stakeholders from across the organization to discuss the underlying factors of model risk, including the nature, number, and riskiness of existing models and the existing control environment.

As illustrated in figure 4 there is an MRM maturity spectrum, and depending on the nature of the model-use environment and degree of existing MRM activities (formal or informal), investment managers can establish a plan or road map to achieving the MRM program that best fits their business and risk appetite.

As a first step, investment managers can benefit largely from compiling a model inventory which allows for better visibility into an institution’s model risk profile and naturally leads to a risk-weighted prioritization of activities and next steps.

## Now is the right time for investment managers to design and implement their MRM frameworks.

There is an increasing sophistication of new models, such as machine learning, artificial intelligence, and algorithmic models, and investment managers will need to balance the risks and returns of leveraging these new methods. Moreover, as the economic environment continues to evolve, investment managers will need to ensure that their existing “time-tested” models are calibrated, controlled, and ready for a new era.

Figure 3. Underlying factors of model risk

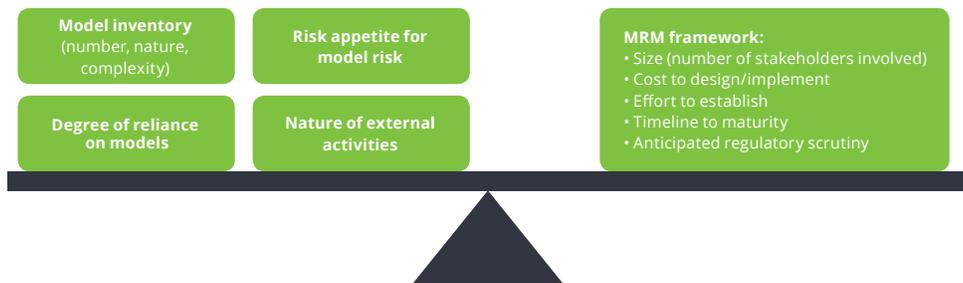


Figure 4. Illustrative MRM program maturity mix

Element of MRM	Basic MRM “Table Stakes”	More advanced MRM “Leading the industry”	
<b>Governance, policies, and controls</b>	<ul style="list-style-type: none"> <li>• MRM policy</li> <li>• Model definition</li> <li>• Risk-rated inventory</li> </ul>	<ul style="list-style-type: none"> <li>• Development and validation procedures</li> <li>• Documentation templates</li> <li>• Reporting and analytics cadence</li> </ul>	<ul style="list-style-type: none"> <li>• Aggregation of model risk</li> <li>• Broader set of procedures (i.e., interconnectedness, monitoring)</li> <li>• Technology/Automation</li> </ul>
<b>Development, implementation, and use</b>	<ul style="list-style-type: none"> <li>• Execution of development procedures for new models using standard templates</li> </ul>	<ul style="list-style-type: none"> <li>• Application of procedures/templates for legacy models</li> <li>• Ongoing monitoring</li> </ul>	<ul style="list-style-type: none"> <li>• Real-time calibration</li> <li>• More sophisticated modeling (ML/AI)</li> </ul>
<b>Model valuation process</b>	<ul style="list-style-type: none"> <li>• Validation of critical models</li> </ul>	<ul style="list-style-type: none"> <li>• Validation of broader model inventory/queue</li> <li>• Use of auto-testing/validation technology</li> </ul>	<ul style="list-style-type: none"> <li>• Streamlined validations</li> </ul>

## How Deloitte can help:

With more than 300 model risk management professionals, Deloitte has helped organizations of all sizes design, implement, and execute their MRM programs. Our team includes former regulators, academics, industry modeling specialists, data scientists, programmers, and risk professionals.



### Model development

- Model development
  - Research and design
  - Data and assumptions
  - Performance testing
- Vendor model calibration



### Validation and monitoring

- Model validation
  - Internal models
  - Vendor models
  - Methodology reviews
- Ongoing monitoring



### Governance/Ops framework

- Policies and procedures
- Inventory and risk-rating
- Technology design/ implementation



### Documentation and analytics

- Template standardization
- Reporting package design
- MRM analytics design

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