Model governance

Today, large financial institutions use mathematical models in their daily operations. This can be compared to airplanes using board computers. However, the use of models for decision making also exposes the institutions to undesired model risk. This can be mitigated by adequate governance.
1. Introduction

Today, large financial institutions use mathematical models in their daily operations. This can be compared to airplanes using board computers. Models are used for various purposes such as ALM, valuation, risk measurement, asset allocation and hedging. In this context, a model is considered as a quantitative method, system, or approach that applies statistical, economic, financial, or mathematical theories, techniques, and assumptions to process input data into quantitative estimates.

The application of models for decision making also exposes the institutions to a new form of risk, i.e. model risk. This is the risk of financial loss or reputational damage resulting from weaknesses in the use of models. Unlike other types of risk, model risk is a secondary type of risk in the sense that it is not rewarded. In fact it only has a downside, no upside.

2. Scope

Model risk can be introduced by any type of model within an organization, ranging from spreadsheet based models to complex IT solutions, from models used by the front office to models used by finance, from pricing models to ALM models.

To have effective model risk mitigation, also supporting systems and processes should be in scope, i.e. the functional operation of the end-to-end system against defined design documentation and the traceability of data flows from source system to final output.

In this context note that in chaos theory, the butterfly effect is the sensitive dependence on initial conditions, where a small change at one place in a deterministic nonlinear system can result in large differences to a later state. The name of the effect, coined by Edward Lorenz, is derived from the theoretical example of a hurricane’s formation being contingent on whether or not a distant butterfly had flapped its wings several weeks before. Therefore, even small supporting models, are in scope as well.

3. Purpose of model governance

Key purpose of model governance is to manage the set of models in such way to reduce model risk. There are four sources of Model Risk:

![Figure 1: four types of model risk](image-url)
4. Model life cycle

Model risk may pop up at any stage during the life cycle of a specific model. The model management process must therefore be defined on this life cycle. The cycle comprises for phases and looks as follows:

1. Start
   The future model user initiates a model origination process.

2. Model Design and Development
   Model developers start the development. All results are recorded in the technical model document.

3. Implementation
   Following development, the model is implemented, tested and rolled out to the users.

4. Periodical Model review
   During the use phase, the model is regularly tested to ensure adequate results. Model monitoring may be considered.

Figure 2: model life cycle

5. Model management process

The model governance process intends to appropriately define the role of each model stakeholder during each phase of the model life cycle. Typical model stakeholders are:

**Model Owner**
Typically the business that requests the model (re)design and that is the main user of the model. The model owner sets the business requirements for the model, is responsible for user acceptance testing and ensures a correct roll out of the model to the users (e.g. training, communication, etcetera).

**Model Developer**
The Model Developer develops, tests and documents the model in accordance with the regulatory requirements and the business requirements set by the model owner. In addition, the Model Developer is responsible for reviewing the model.

**Model Validator**
The Model Validator provides an independent validation of the model. To ensure its independence the model validator abstains from any participation in the model development process. The aim of the validation process is to determine whether a model is (still) appropriate for its use or intended use (“fit for purpose”).
**Model Approver**
All models must be approved by the Model Approver prior to implementation.

**Model Users**
The Model Users use the model outputs in their day-to-day operations. In general, the business that requests the model (re)development and that is the main user of the model.

**Model Auditor**
The Model Auditor performs audits of the model management process. In addition, the Model Auditor may perform special audits in accordance with its audit plan.

**Model Implementer**
All models are implemented. This can either be done within the IT infrastructure (preferred way) or stand alone (e.g. in a local spreadsheet).

Key model stakeholders are part of the three-lines of defense principle:

![Figure 3: model governance concept](image)

*Figure 3: model governance concept*
6. Model inventory

A necessary condition for adequate model governance, is the establishment of a model inventory. This database includes information for all relevant models used within the organization.

The minimum information required per model, consists of:

- Model name (model identification), type and location,
- Model owner (name and function),
- Model type,
- Modeling environment: type of systems used,
- Descriptive characteristics: model uses and/or purposes.

The model inventory will be reviewed periodically. All model changes are to be reflected.

In addition to the above model properties, it may be considered to also classify models in terms of significance. Models can vary in complexity. They may range from simple spreadsheets to intricate simulation engines. They can also vary in impact and in the role they play within an organization. The model’s risk classification can for example be based on its complexity and materiality.
7. Change control

Models can be subject to minor or major changes at any stage during their life cycle (this is particularly true for spread sheet models which are, by definition, highly sensitive to changes). There are four types of change:

<table>
<thead>
<tr>
<th></th>
<th>Intentional</th>
<th>Unintentional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observed</td>
<td>(1) Reflected by a change request of which the model stakeholders are aware</td>
<td>(3) To be identified by a trigger</td>
</tr>
<tr>
<td>Unobserved</td>
<td>(2) Only possible if changes were made by one model stakeholder without informing others.</td>
<td>(4) Not identified and therefore highly undesired.</td>
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Unobserved and unintentional changes (4) represent serious model risk. Therefore, this type of changes must be minimized at all times.

All changes can be classified in terms of impact into for example: Small, Medium, Large and Urgent.
Depending on the type and size of change, the model management process must prescribe appropriate steps to take.
8. Conclusion and considerations

Model governance is pivotal in managing the usually large set of models used within financial organizations. This is particularly relevant in mitigating model risk, i.e. the risk stemming from wrong use of models or use of wrong models or a combination of both. Key challenge in establishing such framework is to define the processes during each stage of the model life cycle and to links these with the role of model stakeholders. For example, once a model is developed by the model developers, it has to be validated by the model validator. The exact scope of validation can be further described in the validation policy (which would form part of the governance framework).

In establishing the model governance framework, we would suggest to consider the following:

<table>
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<tr>
<th>Consideration</th>
<th>Description</th>
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<td>Model management is no box ticking exercise</td>
<td>Model management should seek to go beyond a simple ‘box-ticking’ exercise, reflecting internal management priorities and covering all material aspects of the model environment.</td>
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<td>Proportionality</td>
<td>The investment in model risk mitigating efforts should be in proportion with the materiality (nature, scale and complexity) relative to risk and economic value.</td>
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<td>Consistent process across models</td>
<td>All models in scope should be subject to similar processing. However, less significant models may be treated differently than material models in terms of processing (e.g. more relaxed documentation requirements).</td>
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<td>Pragmatism</td>
<td>The framework is a means to manage model risk, it should not introduce additional risk by demanding disproportionate resources. It is crucial to keep the model governance as simple as possible so that all model stakeholders know what is expected from them.</td>
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Advanced risk models form the basis of our service offer. These models may be employed in a frontoffice environment (acceptance, valuation & pricing) or in a mid-office context (risk management and measurement).

The business areas that we cover are lending, financial markets and insurance. In relation to the models, we provide advice on: Strategic issues; Model development; Model validation; Model use.