

**Management Consulting - Commercial Sector**

# Can Aggregated Model Risk Be Larger Than the Sum of Individual Models' Risks? Why Banks Need to Aggregate Model Risk

Since the end of the financial crisis, there has been increased reliance on quantitative models by financial institutions due to heightened regulatory requirements, including Comprehensive Capital Analysis and Review and Basel. All models are, to some extent, subject to model risk stemming from incomplete data and/or a subjective set of assumptions. While many institutions understand and quantify such risks posed by individual models, few institutions take stock of the holistic risk across their entire model inventories. This siloed view of model risk leaves banks exposed to risks not captured by their risk appetite statements. Further, the lack of a holistic view hinders institutions' ability

to properly quantify overall enterprise risk and model risk's potential organizational impact, preventing leadership from making informed decisions.

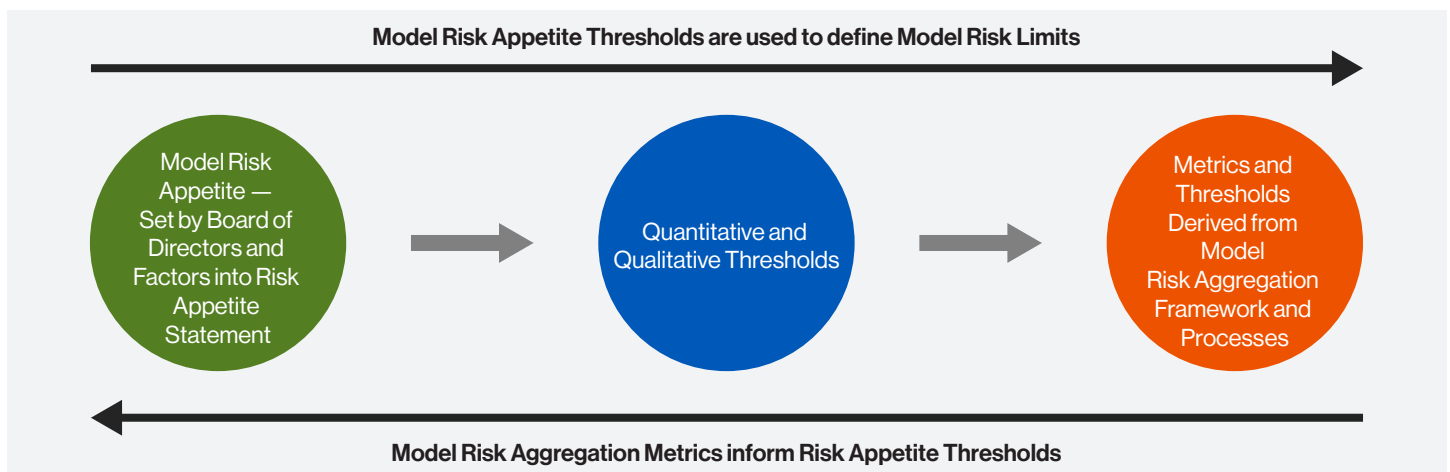
Banks of all sizes continue to wrestle with aggregating model risk across their portfolio, challenged with the process of identifying model information across functions and products, understanding the interconnectedness of their models (downstream/upstream impacts, common assumptions, and shared data), and shortcomings of each model, and then repeatedly applying this process over time.

What steps should banks take to create more consistent, scalable, and repeatable processes across their firmwide model inventories? Model monitoring can be a potential solution. In a 2014 Global Association of Risk Professionals event, the head of model risk management of a prominent financial holding company asserted: "Model monitoring should evaluate whether changes (including anticipated) in products, exposures, activities, clients, or market conditions necessitate adjustment, redevelopment, or replacement of the model."<sup>1</sup> In a similar fashion, aggregated risk models may potentially inform senior leadership on true enterprise risk and enable impactful decision-making.

## Not All Risks Are Created Equal — Model Risk Aggregation Should Inform Risk Appetite

Model risk aggregation is becoming an increasingly important part of the model risk management (MRM) framework for financial institutions of all sizes. Ideally, model risk aggregation can be used to inform the risk appetite framework/statement and vice versa.

**Figure 1:** Setting Model Risk Appetite



1. Please see [http://www.garp.org/newmedia/presentations/modelriskmanagementforbanksandnonbanks\\_082114.pdf](http://www.garp.org/newmedia/presentations/modelriskmanagementforbanksandnonbanks_082114.pdf) for further information.

However, as modeling techniques and methodologies evolve, and model inventories become increasingly diverse, it is becoming more critical to have a model risk aggregation framework in place that can assess model risk consistently across an institution's portfolio.

Aggregating Model Risk has been an explicit regulatory expectation since the publication of the SR 11-7/OCC 2011-12 Model Risk Management guidance (emphasis added):

"In the same manner as for other major areas of risk, senior management, directly and through relevant committees, is responsible for regularly reporting to the board on significant model risk, from individual models **and in the aggregate**, and on compliance with policy."

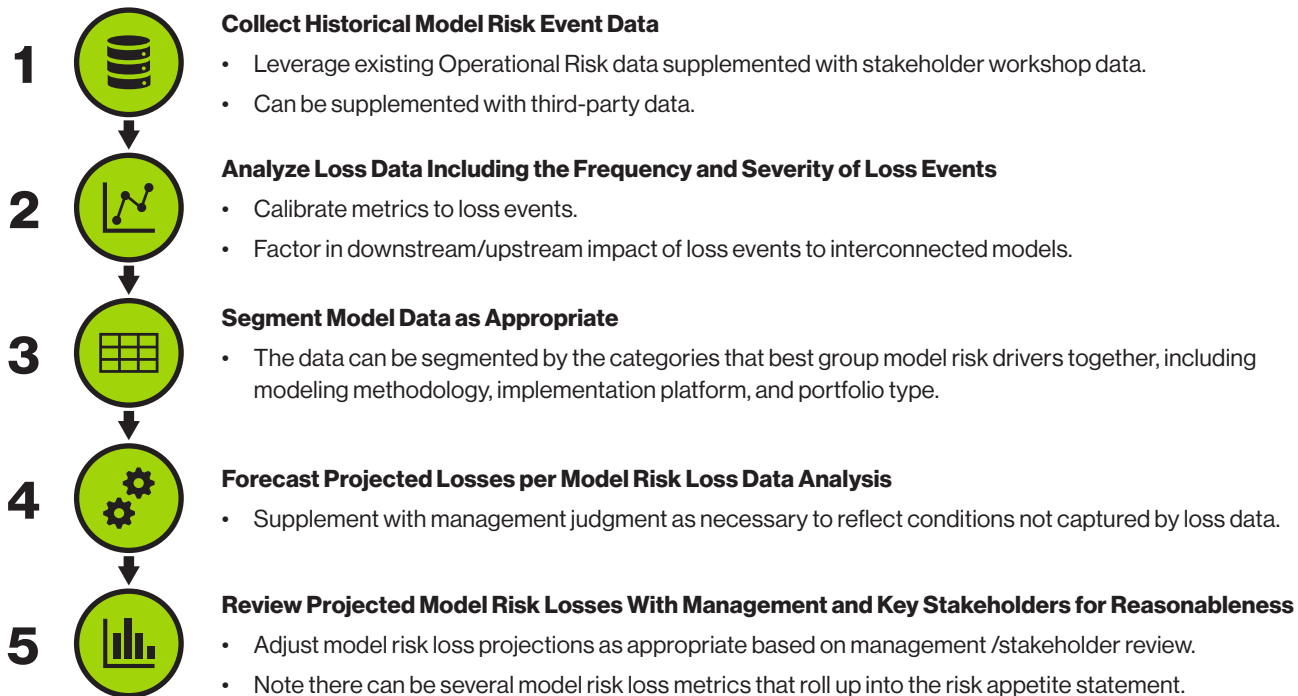
However, regulatory guidance does not prescribe a specific methodology to employ. The type of approach implemented can depend on the size/scope of the institution's model inventory and availability of data and model risk metrics.

## Choosing the Right Model Risk Aggregation Methodology



Here are a few approaches to consider as banks embark on their model risk aggregation program journey.

### Quantitative Approach

A quantitative approach to model risk aggregation involves using existing historical model risk events and their quantifiable impact. If existing historical data is sparse, it can be supplemented by leveraging external data sources and workshops with key model stakeholders to consider additional model risk loss events and a range of outcomes. As shown in Figure 2, models that differ by form and function can be segmented accordingly when aggregating model risk data. Note that several model risk metrics and limitations captured through this process can feed into a bank's risk appetite statement.

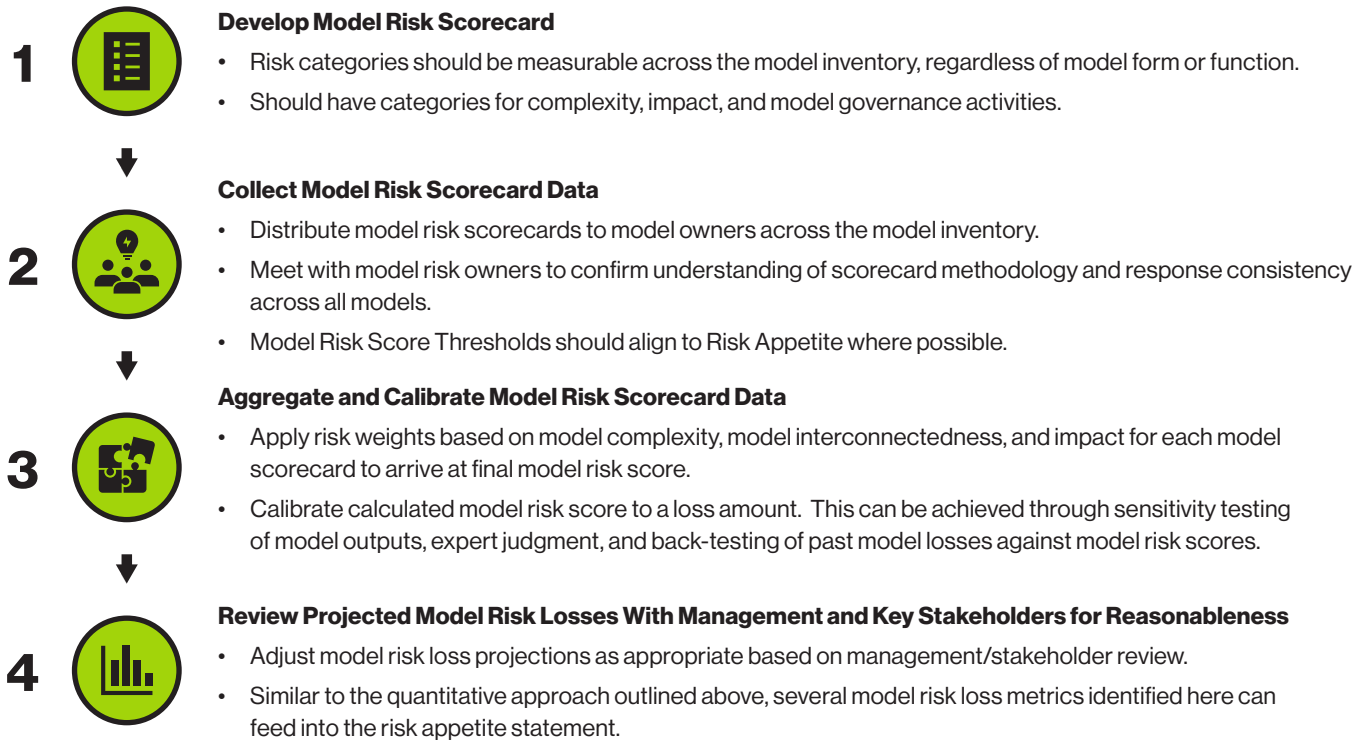


**Figure 2:** Quantitative Approach Overview



 <b>Pros</b>	<ul style="list-style-type: none"> <li>• Can be applied consistently across the firm with limited subjectivity.</li> <li>• Attempts to quantify model risk using actual historical loss event data, providing transparency for regulators and key stakeholders.</li> </ul>
 <b>Cons</b>	<ul style="list-style-type: none"> <li>• Historical model risk loss event data may be limited and may lead to over reliance on assumptions.</li> <li>• Development of a robust historical loss database and simulation of potential impacts may prove difficult to implement.</li> <li>• By using a model to forecast model risk, you introduce additional model risk to the firm.</li> </ul>

## Qualitative Approach

A qualitative approach to model risk aggregation involves using model risk factors and assigning a risk level for each factor (e.g., high, medium, and low) and finally a risk weight for each model based on the models' impact on the firm and any mitigating controls.



**Figure 3:** Qualitative Approach Overview

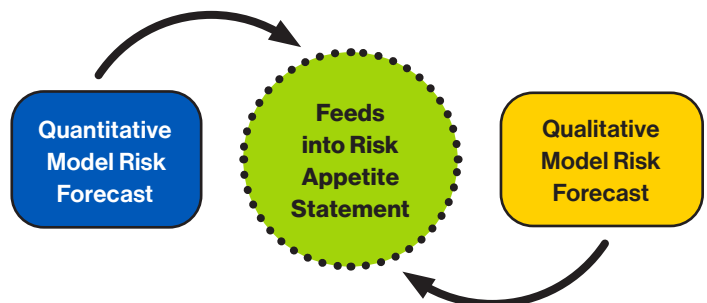
 <b>Pros</b>	<ul style="list-style-type: none"> <li>• Easy to implement across an institution's model inventory.</li> <li>• Can be clearly understood by key stakeholders and senior management to make actionable decisions against the output.</li> <li>• Incorporates all key model risk factors, including model interconnectedness.</li> </ul>
 <b>Cons</b>	<ul style="list-style-type: none"> <li>• Metrics, risk level thresholds, and weights are highly subjective and dependent on assumptions and judgment.</li> <li>• While the approach aggregates total model risk, it does not directly tie model risk to estimates of financial loss, correlating context to the risk level.</li> </ul>

## Hybrid Approach

Institutions that prefer the refinement and transparency of the quantitative approach but, given the scarcity of data, need to rely heavily on judgment, may wish to implement a hybrid approach that includes elements of both methodologies.

One way to accomplish this is to start with quantitative metrics and loss event data, while leveraging the qualitative approach, including scorecard data as an overlay to enhance the results where applicable (but on a consistent basis). As the quantitative portion of the approach matures and is calibrated to a larger historical loss data set, the qualitative approach will become less prominent, used only to incorporate the underlying risks not captured by the loss data.

An ancillary benefit of using both approaches is that they may provide an indicator of when either approach needs to be recalibrated, typically if there is a large deviation in results. Further, this approach provides a more robust set of metrics and thresholds, which can inform the firmwide risk appetite statement.



## Conclusion — Consistency Is Key

As the MRM field advances, institutions should look to shift their primary focus from assessing individual model risk to firmwide model risk aggregation. Given the complexity of gathering model risk information across an organization, model interconnectedness, and the variety of model forms and functions, this can be one of the more challenging areas of MRM. Based on an entity's MRM framework, model inventory, and availability of model risk metrics, there are a variety of approaches that can be used when aggregating model risk. The most important thing when deciding on a model risk aggregation methodology is implementing the approach that can be applied consistently over time while properly capturing the underlying risks of the model inventory.

Institutions that master processes around aggregating model risk will be able to provide senior leadership with a more accurate view of these risks across their model inventories to better inform key decision-making.



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Find this insightful? Read "[Managing Machines — Governance Is Key to Unlock Machine Learning Value](#)," which discusses the crucial role that governance plays and steps to implement a model risk management program.



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