Risk Solutions

CRISIL
An S&P Global Company

Model risk management

Mitigating the risks emanating from model usage

Contents

Executive summary

Financial institutions (FIs) are increasingly using decision models across credit lifecycle processes such as origination, credit monitoring, portfolio management, collection and recovery.

The analytics used is getting increasingly complex, driven by exponential proliferation of data and computing ability. Consequently, models have become more complex and difficult to understand.

These models also expose the FIs to risks associated with decisions based on incorrect models, financial losses, capital liquidity shortage, and loss of customers. Such risks are collectively referred to 'model risk'.

We believe this is a major risk and needs to be proactively managed instead of reactively.

Though model usage has seen a sharp increase among FIs, the measurement of risk associated with their usage is largely overlooked. This can be attributed to the dearth of regulatory suasion, unlike in other risk areas.

Regulators in the developed markets have become cognizant of the costs associated with model risk and have therefore formulated guidelines around it, such as the US Federal Reserve's SR 11-7 and the European Banking Authority's guidance note CP/2014/14.

However, regulators in the emerging economies are yet to do so despite model usage in their markets reaching the scale of the developed world.

That's why we believe FIs in emerging markets should put in place a holistic model risk management framework for systemic mitigation.

In this report, we highlight the challenges ahead of model-driven organizations in emerging markets, underscore the missed opportunities, and present CRISIL Risk Solutions' framework for alleviation through effective quantification of model risk.

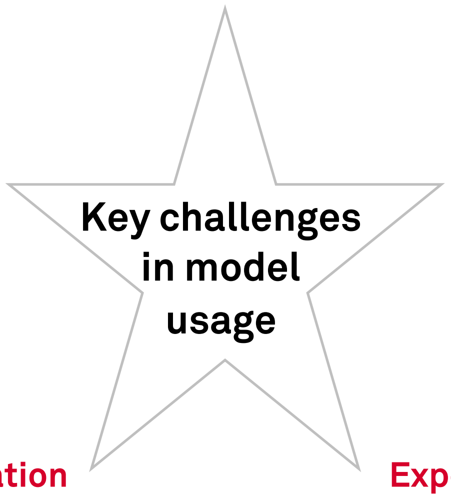
Challenges in model usage in emerging markets

Emerging markets have seen an increase in the usage of models, and this has spawned unique challenges. Simply put, FIs haven't been able to put together prudent practices for model-driven organizations.

The risk gets magnified because there is information asymmetry between the analytics teams and business executives responsible for the overall enterprise-wide risk. Reliance on vendor models, or those designed by third parties based on external data sources, further compounds the risks.

Lack of prudent governance practices

FIs often utilize some analytics team for model development and validation, thereby compromising the objectivity of the validation process. This results in not-so-prudent governance practice



Inadequate techniques to quantify model risk

Lack of measurable risk metrics and aggregation methods for model risk across businesses and organization are largely unaddressed and limits the model risk management capabilities

Lack of quant-oriented risk managers

Compartmentalization of the risk and analytics function has created a vacuum of professionals who could bring in business perspective to outcomes of quantitative models. This exacerbates the risks posed by the models.

Information asymmetry

Ad hoc reporting using non-standard metrics and formulae increases the information asymmetry between model owners, users, and top management. This constrains the speed and efficacy of the decision-making process

Exposure to vendor models

FIs have high reliance on vendor models for decision-making. Since they did not have control in the model development process, the risks associated with such models are even greater and need to be actively monitored and mitigated

Existing policy framework and infrastructure of the FIs are inadequate to transition from a people-driven ad hoc model risk management to a systematic, enterprise-wide model risk management framework. FIs have found it challenging to establish a model risk management process that's transparent and meets the expectations of all stakeholders.

Going beyond compliance to mitigate business risks

The utility of a robust model risk management framework extends beyond regulatory compliance. It is integral to the running a financial services business because it drives better decision-making and impacts business results.

A sound model risk management framework helps an FI to optimize regulatory capital, pre-empt major model-related losses, and manage provisioning volatility. It can provide the competitive edge in a fierce lending market.

IFRS9 will link model output with the income statement of the bank. Lack of stability in the model would result in volatility in net income. Periodic monitoring of the model can help the bank overcome this.

A program-based approach to model risk management would avoid the ad hoc reporting and analysis related to model performance. That would bring in operational efficiencies within the overburdened analytics department of bank.

Benefits of an effective model risk management framework

Optimize RWA

Continuous monitoring of model calibration helps financial institutions in optimizing its risk-weighted assets (RWA) and avoid cases of under- or over-assignment of risk weights to exposures

Minimise Capital losses

Active management of model risk prevents a bank from incurring severe losses because of incorrect usage of models caused by a change in product, exposure, activity or market condition

Model risk management framework

Achieve operational efficiency

Model risk management would help FIs align model investments with business risks and priorities model development and validation efforts

Reduce earnings volatility

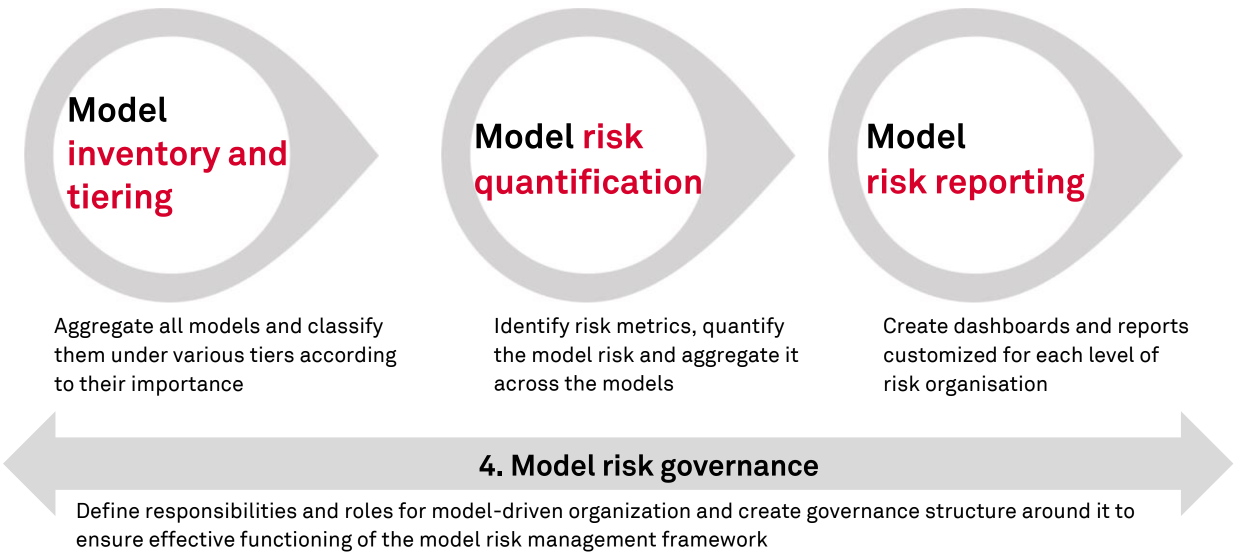
A strong model risk management framework would ensure model stability and minimize volatility in earnings. This is especially true with the upcoming IFRS9 regulations, which will connect risk assessment models with provisioning

FIs have very strong incentives to establish an organized approach to model risk management, leading to highly rewarding results. A fully functional system would enable automated model monitoring performed on a periodic basis with associated decision triggers, making the whole cycle of model performance management inexpensive and industrialized.

CRISIL Risk Solutions approach for model risk management

For CRISIL Risk Solutions, the model risk management program is a four-pronged approach. It would cover identification of models, quantifying the risk around them, industrializing reporting, and creating governance around previous steps.

Steps to an effective model risk management framework



1. Model inventory and tiering:

Developing an exhaustive model inventory is one of the most important steps for an effective model risk management system. The inventory enables FIs to bring all model-related information on a single platform, such as intended usage, stakeholders, and materiality of the model versions to be easily accessible to the right people at various levels.

Illustrative example of grading a model inventory

Model ID	Portfolio	Type	Business
1	Infra loan	Risk	Corporate
2	Vehicle loan	Risk	Retail
3	Home loan	Risk	Retail
4	Corporate	Risk	Corporate
5	Trader	Risk	SME
6	Corporate bonds	Pricing	Fixed income
-	-	-	-
N	**Economic capital**	**Regulatory**	**Group**

➕

Tiered model inventory

Materiality (Economic / regulatory consequences)	Computation complexity	Decision impact

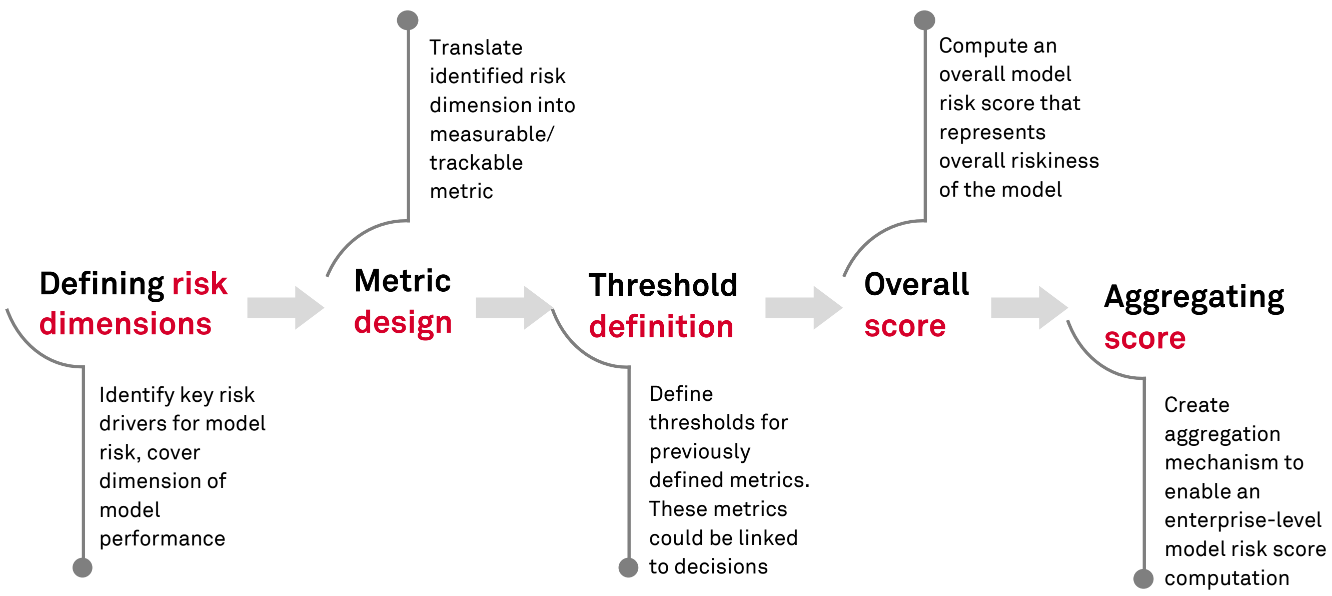
Model ID	Portfolio	Type	Business	Tier
1	Infra loan	Risk	Corporate	Tier1
2	Vehicle loan	Risk	Retail	Tier1
3	Home loan	Risk	Retail	Tier2
4	Corporate	Risk	Corporate	Tier3
5	Trader	Risk	SME	Tier1
6	Corporate bonds	Pricing	Fixed income	Tier3
-	-	-	-	
N	***Economic Capital***	***Regulatory***	***Group***	**Tier3**

Segmenting models into risk tiers is also an important component of model inventory preparation. Model tiers could be classified based on the impact assessment of a model in the overall functioning of the FI. All models need to be classified in the risk tiers so that FIs have a view of performance at each tier level.

2. Model risk quantification

Quantification and aggregation of model risk across the business units and organization is one of the biggest challenges faced by FIs when implementing a robust model risk management framework. Effective quantification mechanics would follow the process flow stated in the chart below:

Model risk quantification methodology



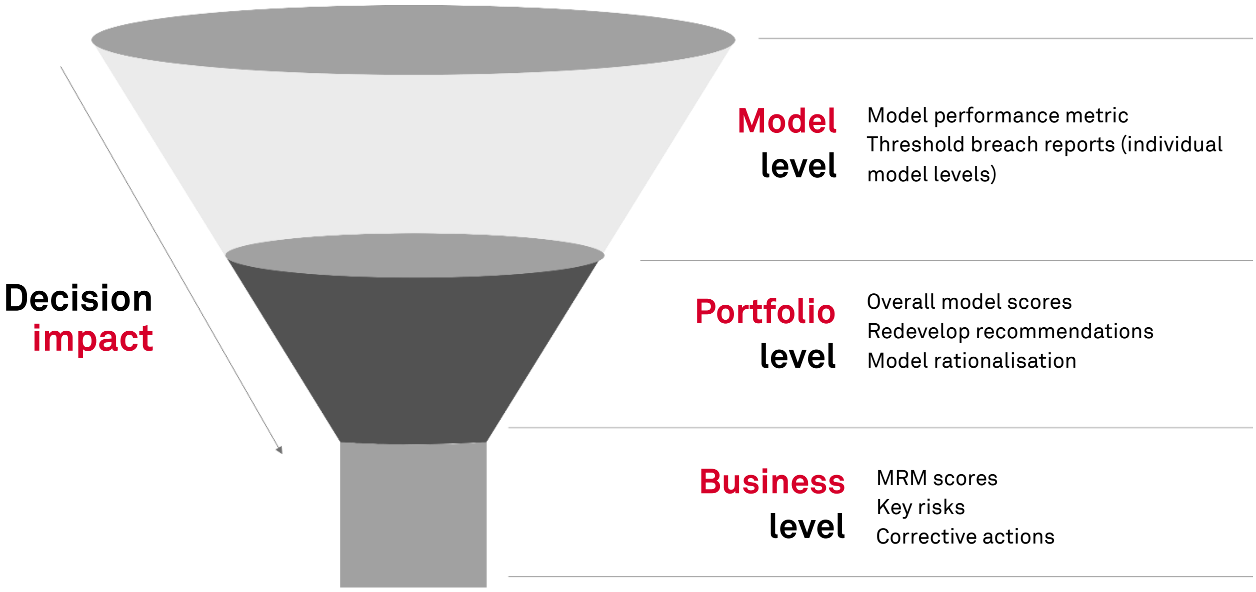
For a credit risk model, the Bank of International Settlements has released a working paper highlighting the risk dimensions that could be used as a reference (*see appendix*).

3. Model risk reporting

Once the model risk has been quantified, the FI should establish a reporting mechanism to ensure that appropriate information is made available to relevant stakeholders at the appropriate time. The reporting should be structured for three levels – the analytics team, portfolio management, and the business/enterprise.

The analytics team level reporting should be highly detailed, presenting the nuances of performance tests at each model level. At the enterprise level, highly aggregated model risk management scores should be presented along with details of the problematic models so that corrective actions could be sanctioned.

Model risk reporting framework



A good reporting structure would remove the information asymmetry across the FI, and would help the senior management be fully aware of the overall health of its model infrastructure. The management should also know about the models whose performance has deteriorated and flag the requisite inputs, including mitigations, to sanction corrective actions.

4. Model risk governance

The model risk management framework, as part of the governance mechanism, should clearly establish roles and responsibilities of stakeholders, with the oversight mechanism and policy and controls as its fulcrum. It should ensure roles and responsibilities, and adherence to policy and standards throughout the model lifecycle management.

Some of the key elements of a best practice model governance framework are:

- Clearly demarcated roles and responsibilities to establish accountability

- Comprehensive policies and documented operating procedures setting out performance thresholds, range of outcomes, and associated action items
- Adherence to policy and standards by adequately defining risk controls

Elements of an effective governance structure

Role charter	Policies	Risk controls
Define the function of each of the following with regard to model risk management: • Model developer • Validator • Model auditor • Oversight committee • Board	Define the policies governing: • Data management • Documentation • Vendor models • Validation and redevelopment • Action approvals	Defined detailed risk controls to ensure that policies are adhered to and charters are properly followed

Sound governance of model risk

An effective governance structure is essential to ensure smooth and effective functioning of the model risk management framework.

Appendix

Credit risk models can be assessed for their discrimination power, applicability of calibration and stability of population. These factors, when measured with appropriate tests, would provide an objective assessment of model risk.

Risk Dimensions	Performance Metric
Discrimination These tests assess the ability of model to distinguish between good and bad borrowers	**Gini Measures** **KS Distance** **Entropy Measures**
Calibration These tests assess whether the model's rating grades are reflective of actual default probabilities	**Hosmer Lomeshaw Test** **Binomial Test** **Traffic Light Test**
Stability These tests assess whether there has been a significant change in the population compared to development set	**Population Stability Index** **Default Distribution** **Default Distribution**

Details of these tests could be found in Bank of International Settlement's Working Paper 14. (http://www.bis.org/publ/bcbs_wp14.pdf)

Analytical contacts

Somdeb Sengupta, FRM(GARP)
Director
CRISIL Risk Solutions Limited
Somdeb.Sengupta@crisil.com

Manpreet Singh Rekhi
Manager
CRISIL Risk Solutions Limited
Manpreet.Rekhi@crisil.com

Vivek Singh, CFA
Manager
CRISIL Risk Solutions Limited
Vivek.Singh@crisil.com

About CRISIL Limited

CRISIL is an agile and innovative, global analytics company driven by its mission of making markets function better. We are India's foremost provider of ratings, data, research, analytics and solutions. A strong track record of growth, culture of innovation and global footprint sets us apart. We have delivered independent opinions, actionable insights, and efficient solutions to over 100,000 customers.

We are majority owned by S&P Global Inc., a leading provider of transparent and independent ratings, benchmarks, analytics and data to the capital and commodity markets worldwide.

About CRISIL Risk Solutions

CRISIL Risk Solutions (CRS) provides a comprehensive range of risk management services, analytics and solutions to financial institutions, banks, insurance and corporates in India, the Middle East, Africa, South Asia and South-East Asia. We are a division of CRISIL Risk & Infrastructure Solutions Limited (CRIS), a wholly-owned subsidiary of CRISIL Limited, and have been ranked India's No. 1 Risk Solutions provider in a survey by Indian Banks' Association. Our solutions help clients identify, measure, and calibrate a comprehensive range of risks: credit risk, operational risk, regulatory risk and market risk. Our expertise in executing and managing diverse risk-related engagements, in-depth knowledge of regulatory requirements, and a pool of experienced professionals enable us to deliver enterprise risk management solutions from ideation to implementation. We supplement our core risk domain understanding and analytical skills with robust proprietary softwares to provide efficient solutions for risk management. Our software and service offerings include model development and validation, diagnostic analysis, framework development, formulation of policy & processes, corporate & retail credit lifecycle management solutions, integrated risk management solutions and regulatory reporting solutions.

CRISIL
An S&P Global Company