

Deloitte.



Model Risk Assessment

2nd MRM Event

26th of April 2017, Paris

Agenda

17h00	OUVERTURE	Nadège Grennepois, Deloitte
17h10	MODEL RISK ASSESSMENT FRAMEWORK	Michel Guidoux, Deloitte
17h10	SAS MRM INTRODUCTION	Birame Fall, SAS France
18h00	MRM PROJECT AT TD BANK	Robert Rapacciuolo, TD Bank
18h30	ROUND TABLE AND Q&A	Sophie Briot, BNP Paribas, Guillaume Figer, Société Générale, Guillaume Tabourin, BPCE, Hervé Phaure, Deloitte, Robert Rapacciuolo, TD Bank, Renzo Traversini, SAS
19h00	NEXT STEPS	Nadège Grennepois, Deloitte
NETWORKING COCKTAIL		



Introduction

Nadège Grennepois, Deloitte >

MERCI !



French Banks MRM Exchange Group

FRENCH MRM GROUP OBJECTIVES

Build an **exchange environment** to **share the MRM practices** within the French banking industry.

Organise regular events in order to **benchmark the activities** and the **state of the art** on the implementation of an effective MRM framework.

Identify the **best practices and the key areas of concern**.

Develop a **common MRM culture** in France.

Deloitte France relies on:

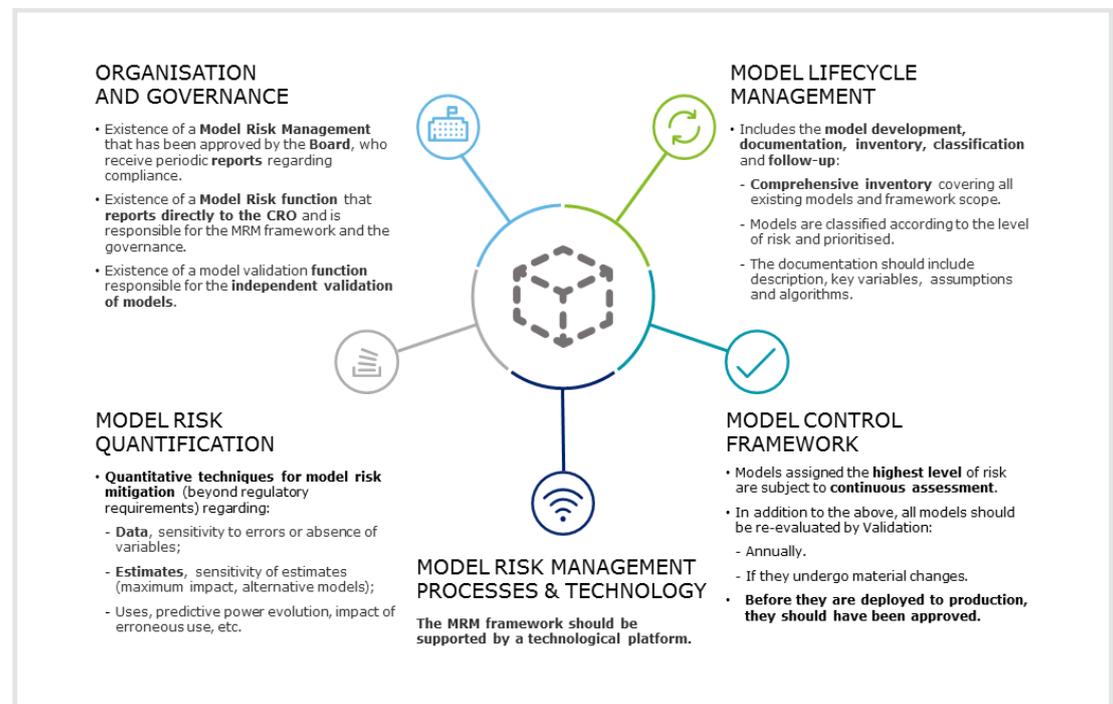
- An EMEA MRM Group with representatives from: Italy, Germany, Netherlands, Spain, Belgium, Luxembourg, Austria, Poland, Portugal, UK and US
- The Deloitte Banking Union Center in Frankfurt (BUCF) Technical Experts Group and CRO Club at European level

MRM Events are planned at a global level:

- MRM Paris Conference in December 16 with 25 representatives from the French banks in Paris
- BUCF TEG meeting in May 17 with major European banks representatives in Madrid (hosted by BBVA)
- GFSI RCM Leadership Partners meeting (March 17) in New York
- MRM EMEA Workgroup Meeting (April 17) in Paris
- EMEA FSI R&CM meeting (April 17) in Hamburg

Topics discussed during the first French MRM event with the participation of speakers from BaFin, Société Générale, BNP Paribas and BPCE:

- Regulatory environment
- Organisation and Governance
- Model Lifecycle management & Process
- Model Validation
- Model Risk Quantification
- Impact on the bank's profitability



Model Risk Management Conference

The 12th of December, Paris

MAIN TOPICS COVERED (1/2)

Scope

Proxy models or expert judgement models should be integrated in the scope and people should anticipate their formalisation (documentation).

Non regulatory models should be integrated in the MRM framework. Bank should identify incentives in order to classify and prioritise them.

MR Assessment

Portfolios of models (interconnected or linked models) should be considered when assessing model risk.

There should be a difference between the intrinsic model risk that is linked to uncertainty (can be already taken into account in pillar 1 capital via the prudent valuation for pricing models) and the operational risk which comes from model errors (misuse, error in implementation, model governance breach for example).

The Model Risk scorecard (or rating) should have a bi-dimensional approach:

- 1st dimension: assess the materiality
- 2nd dimension: assess the quality of the model

Model Risk rating enables to target the relevant models (and decide to spend more time on the models that are more important, more material and more complex).

The prevention and the mitigation are also important (banks should consider developing more simpler models with a low maintenance cost and a better transparency).

Model Risk Management Conference

The 12th of December, Paris

MAIN TOPICS COVERED (2/2)

Organisation & Processes

Consider leveraging on the existing framework for regulatory models and ensure a wider view of the models through a transverse layer.

The implementation of a MRM framework should start with the governance and the organisation:

- Start sharing practices and develop the MRM culture (US to Europe)
- Create a vocabulary that is known by people in the organisation
- Start prioritise models: those that are more relevant, more material and more complex
- Create a map of the models and a dashboard (or leverage on what it is already available) → Banks consider this being a work for the 5 years to come...

Create a Model Risk Committee (like for any other type of risk in a bank).

Proportionality principle approach: start by having some minimum set-up, a step by step approach.



Model Risk Assessment Framework

Michel Guidoux, Deloitte 

How important is model risk?

Model risk may be particularly high, especially under stressed conditions or combined with other interrelated trigger events.

JP Morgan – The London Whale

Impacts: the bank made losses of £6bn and was fined £1bn

What happened ? The bank's Chief Investment Officer was responsible for investing excess bank deposits in a low-risk manner. To hedge against possible downturns in the economy, the CIO bought synthetic CDS derivatives. Initially intended as an hedging strategy, this portfolio became a speculative source of profit and increased from \$4bn in 2010 to \$157bn in early 2012. However, the internal risk controllers duly reported those trades as being too risky.

How is model risk involved? Instead of scaling back the risk, the bank changed its VaR metric in early 2012. But there was an error in the spreadsheet used for that purpose and the risk was understated by 50%. This error enabled the portfolio to continue growing, but the bank was then hit by the European sovereign debt crisis.

LTCM – Arbitrage investment strategies

Impacts: the hedge fund lost \$4.4bn in 1998, depleting almost its entire capital

What happened ? The hedge fund was established by renowned bond traders and the main shareholders included Nobel prize-winning economists (Myron Scholes and Robert Merton). Investors consisted in high net worth individuals and in financial institutions. The fund had followed an arbitrage investment strategy on bonds, involving hedging against a range of volatility in foreign currencies and bonds, based on complex models.

How is model risk involved? Arbitrage margins are small and the fund took on leveraged positions to maintain or increase profits. At one point, the notional value of the derivative position was \$1.25tn. When the Russian crisis kicked off in 1998, European and US markets fell drastically and LTCM was badly hit through market losses and fire sales.

CDO / MBS – 2007 subprime mortgage crisis

Impacts: one of the main cause and source of losses in the 2007 financial crisis. As-of Sept. 2008, bank write-downs and losses totaled \$523bn.

What happened ? Rating agencies had provided a AAA rating to a significant portion of securities backed by pools of loans including a significant proportion of loans to homebuyers with bad credit and undocumented incomes (subprime mortgage loans)

How is model risk involved? Between 2002 and 2007, the mortgage underwriting standards had significantly deteriorated. However those loans bundled into MBS and CDO with high ratings which were believed justified by credit enhancement techniques. Investors relied on rating agencies, blindly in many cases. However, a significant portion of AAA CDO and MBS tranches were finally downgraded to junk in 2007 and early 2008, once the housing bubble burst in the 2006 H2.

The US Financial Crisis Inquiry Commission found that agencies' credit ratings were influenced by *"flawed computer models, the pressure from financial firms that paid for the ratings, the relentless drive for market share, the lack of resources to do the job despite record profits, and the absence of meaningful public oversight"*.

Regulatory market risk pre-crisis models

Impacts: the VaR metrics used before the outburst of the financial crisis did not adequately capture tail-risk events, credit risk events as well as market illiquidity.

What happened ? When the financial crisis arose, essentially driven by credit risk events, a large number of banks posted daily trading losses many times greater than their VaR estimates and quite frequently during that period, in a context where some financial markets became largely illiquid.

How is model risk involved? The market risk model was build upon assumptions that were not reflective of the real world in stressed financial markets (assuming market liquidity and large diversification effects across asset classes, etc.). In addition, tail credit risk events were not adequately modelled, hence underestimating possible losses in stressed conditions.

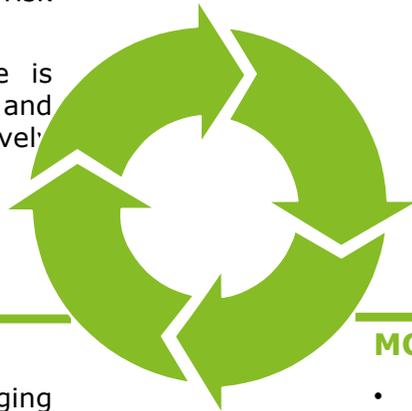
What is the main purpose of model risk assessment?

Model risk assessment underpins and supports a robust model risk governance

Ability to provide a comprehensive and consistent view on model risk at a defined level of aggregation is an important goal of a MRM framework. Through the MRM framework in place, the Senior Management should get a general idea of where the model risk issues are, how significant they are, and what are they root causes.

MODEL RISK APPETITE

- The expression of the Board's appetite for model risk is one of the crucial steps in robust model risk management.
- As for any other risks, model risk appetite is articulated in the form of appetite statements and of risk tolerance limits applied to effectively monitored model risk metrics.



MODEL RISK POLICY

- An overarching Model Risk Policy sets out the roles and responsibilities of the various stakeholders in the MRM framework, including those of the 3 lines of defence and of model owners, accompanied with the group-wide modelling and MRM standards:
 - model risk definition and identification tailored to the bank
 - monitoring of MRM: model risk KPIs and metrics
 - specific requirements for the development, validation and use of model

MODEL RISK REPORTING

- The Board has ultimate responsibility for managing the firm's model risk. It is therefore important that information provided to the Board and BRC enables effective oversight of that risk:
 - Model risk profile against model risk appetite boundaries
 - Qualitative information (outcomes of model validation, weaknesses and remediation actions, emerging trends in model risk)
 - Model risk assessment (changes in model materiality, changes in model health, model risk assessment and quantification measures, etc.)

MODEL RISK MITIGATION

- To reduce exposure to model risk and to ensure the bank constantly operates within the boundaries of its risk appetite, model risk mitigants are to be prescribed when model health is weak or deteriorating:
 - A broad range of model risk mitigants are available depending on model types concerned, its purpose and the modelling issues met.
 - Proper implementation of model risk mitigants is primarily under the responsibility of model owners. However, appropriate checks should be performed by the 3 lines of defence, including the independent validation function, as appropriate.

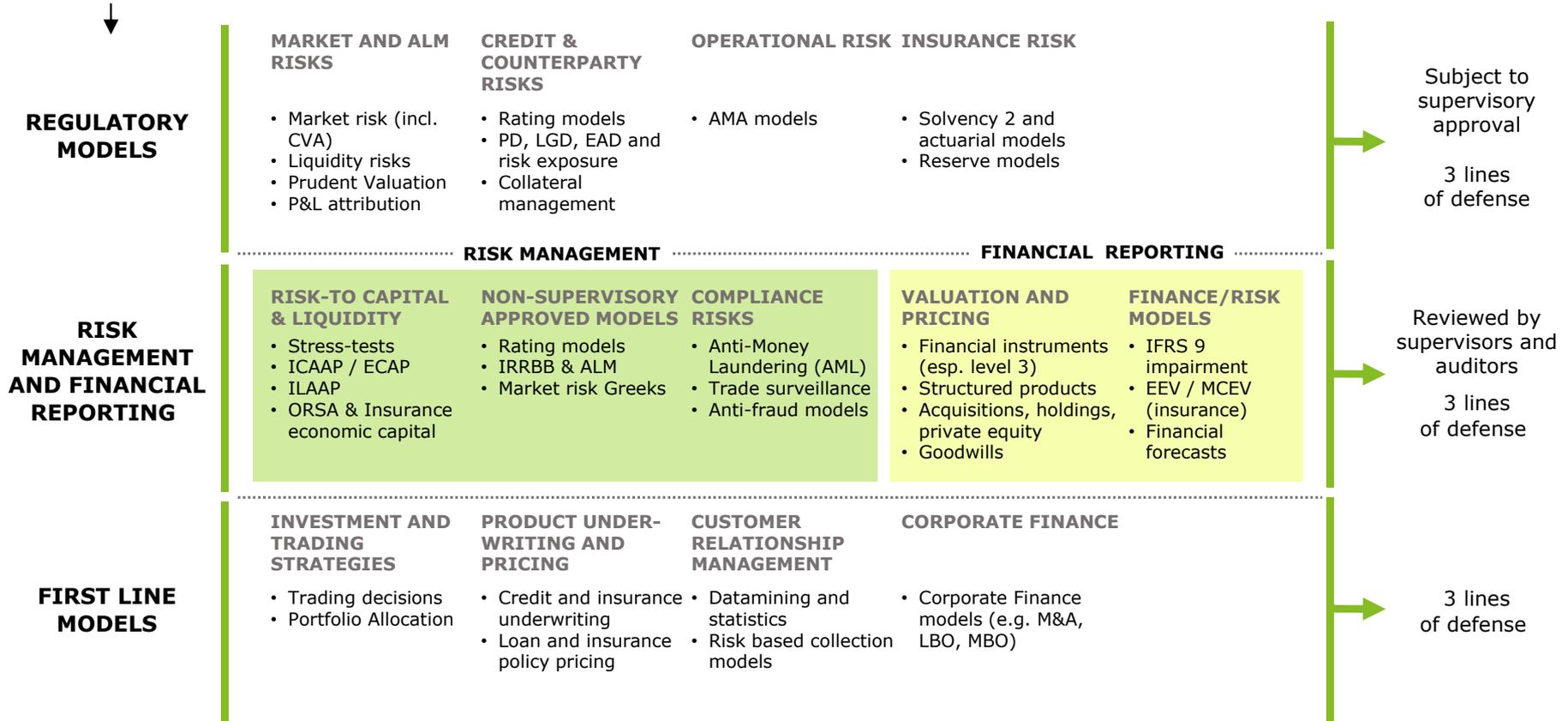
What is the model landscape?

Various categories of models, depending on their purpose and underlying methodologies

MODEL DEFINITION*

- A quantitative method, system, or approach that applies statistical, economic, financial, or mathematical theories, techniques, and assumptions to process input data into quantitative estimates.
- A *model* consists of three components: an information input component, which delivers assumptions and data to the model; a processing component, which transforms inputs into estimates; and a reporting component, which translates the estimates into useful business information.

- **Quantitative models**
- **Expert-based models**
- **Identification of EuCs meeting the model definition**
- **Use of new technologies in modelling processes (machine learning, robotics, AI, etc.)**



(*) SR 11-7, US FED, 4 April 2011

What are the key considerations in model risk assessment?

Classification of model importance and of model risk sources

Assessment of model materiality helps in prioritising actions and in rolling-out the MRM framework. There might not be a unique view of what are the most significant drivers of model materiality, although the regulatory context and possible operational / compliance risks should be seen as key drivers.

The health assessment framework in place should enable to highlight the most important causes or issues met ("root cause" approach instead of a mere assessment). It should capture the feedback received from Supervisors, Auditors and other lines of defence.

Model risk inherent to models used for multiple purposes may vary depending on each particular context of use, which need to be inventoried.

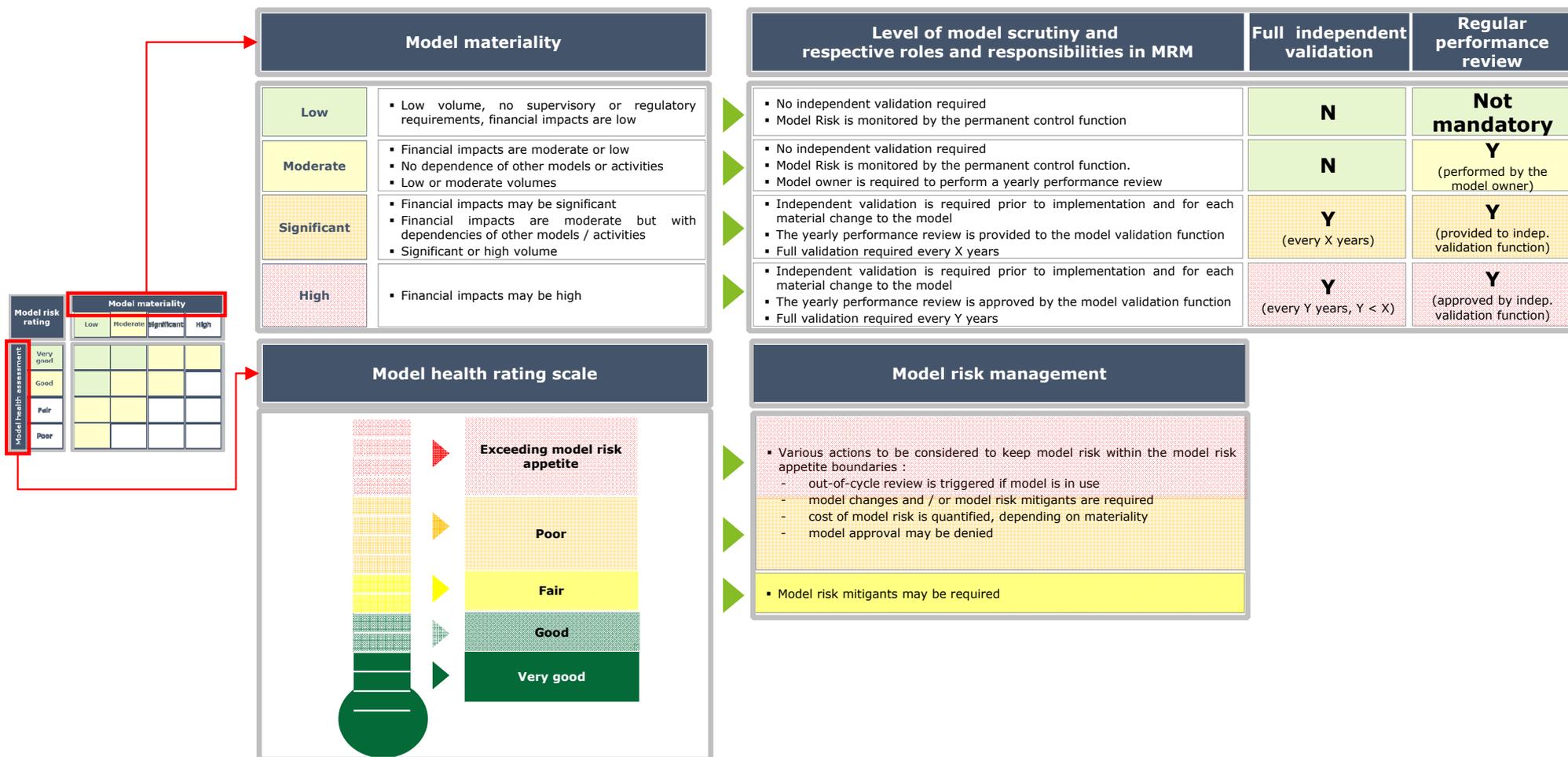
Model risk rating may differ before and after mitigants.

		Regulatory models	Risk management models	Financial reporting	First line models
Model materiality	Volume	<ul style="list-style-type: none"> Gross exposure amounts 	<ul style="list-style-type: none"> Gross exposure amounts 	<ul style="list-style-type: none"> Gross exposure amounts 	<ul style="list-style-type: none"> Frequency and number of decisions taken
	Context of use	<ul style="list-style-type: none"> Compliance with regulation Dependence of other models or activities Automated decisions vs. overrides able to challenge model outputs 	<ul style="list-style-type: none"> Supervision / regulation Dependence of other models or activities Automated decisions vs. overrides able to challenge model outputs 	<ul style="list-style-type: none"> Financial statements Compliance with standards Dependence of other models or activities Automated decisions vs. overrides / challenge 	<ul style="list-style-type: none"> Dependence of other models or activities Automated decisions vs. overrides able to challenge model outputs
	Financial impacts	<ul style="list-style-type: none"> Significance / weight in regulatory ratios Volatility of gains / losses of relevant activities Impacts if supervisory model approval is removed 	<ul style="list-style-type: none"> Operational & non-compliance risks Volatility of gains / losses of activities concerned Reputation risk 	<ul style="list-style-type: none"> Operational & non-compliance risks Volatility of gains / losses of activities concerned Reputation risk 	<ul style="list-style-type: none"> Operational & non-compliance risks Proportion of P/L dependent on model for decision-making Opportunity costs Reputation risk
Model health assessment	Data	<ul style="list-style-type: none"> Data quality and integrity, wrong data inputted in models Other data limitations: availability / scarcity, use of external data, changes in definitions over time, etc. 			
	Modelling choices	<ul style="list-style-type: none"> Theory: non-standard & emerging model theory, un-tested limitations in underpinning theories/assumptions, proxies Obsolescence, non-approved material changes Modelling complexities, missing variables, misspecifications 			
	Model uncertainties	<ul style="list-style-type: none"> Scenario analyses: model behaviour in stressed or extreme conditions Sensitivity analyses: sensitivity to variations in estimations of input parameters, to available data and to changes in assumptions Benchmarking analyses: comparison of outputs and theories to alternative modelling choices Stability & robustness: population stability, input and output stability, etc. 			
	Model accuracy	<ul style="list-style-type: none"> Backtesting: actual performance vs. past experience Discrimination power (if applicable) Limited range of validation techniques used (incl. expert-judgments, reasonableness checks, etc.) 			
	Model environment and use	<ul style="list-style-type: none"> Model infrastructure: (resources, systems / processes) Model governance: model challenges, permanent controls, on-going accuracy checks Model not used as intended Model interconnections: upstream and downstream dependencies to other models 			

		Model materiality			
		Low	Moderate	Significant	High
Model health assessment	Very good				
	Good				
	Fair				
	Poor				

What are the key considerations in model risk assessment?

Level of scrutiny adapted to the level of model risk



Roles and responsibilities

Delineation of R&R in MR assessment

If the establishment of a MRM function plays a central role in the implementation of a robust MRM framework, there might be various organisational options to consider with each having its pros and cons: the MRM function may be (i) a separate function within the 2nd LoD, (ii) grouped with / reporting to the model validation function.

MODEL BUILDERS / MODEL USERS

- Distinction to be made between model builders and users
- Clearly establish their respective duties and responsibilities in MRM
- Clear model ownership framework to be established (especially for models used in a number of entities / BLs)
- Both model builders and users are subject to model construction and MRM policies (incl. model risk assessment)

MODEL VALIDATION

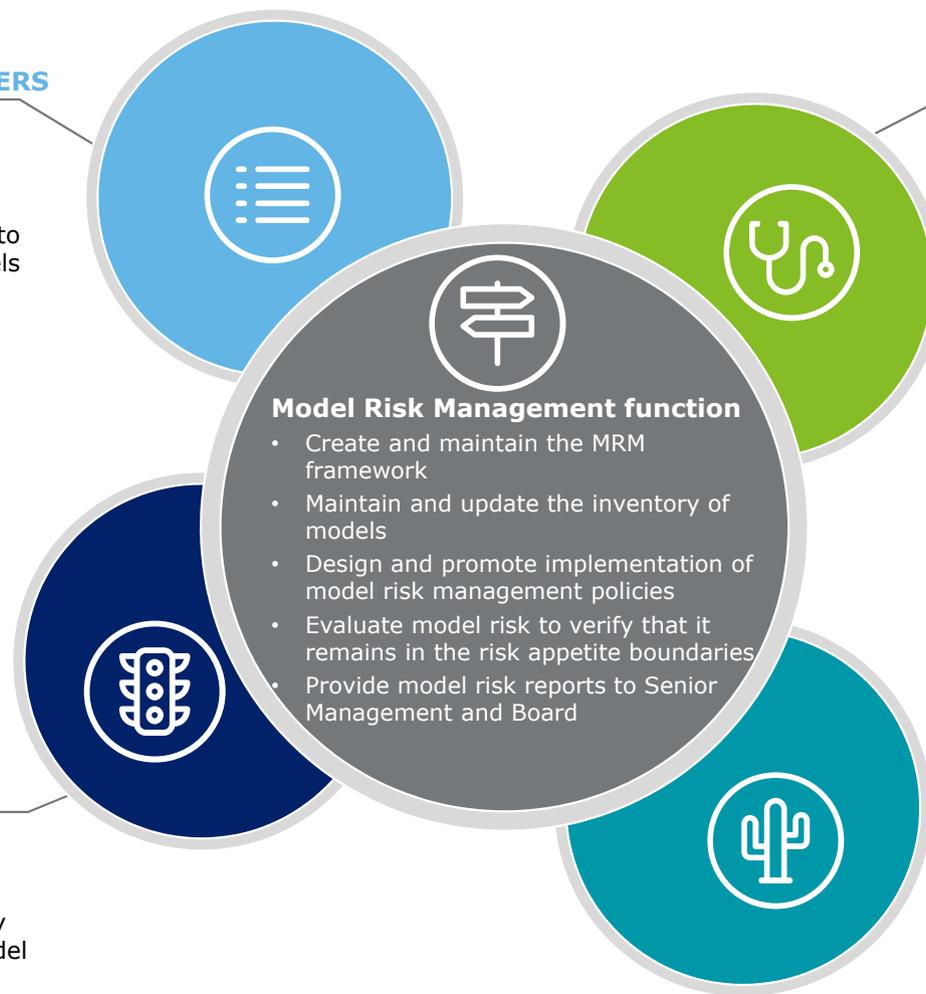
- Perform model validation tests and performance review for models whose model risk is deemed significant or high
- If model health is 'poor' or 'fair', is empowered to propose model risk mitigants and quantification of model risk, in liaison with model owners and with the MRM function
- As an outcome of model validations and performance reviews, confirm or amend model risk ratings
- Strong integration of model validation into a firm's risk culture

THREE LINES OF DEFENCE

- Implement a model risk control framework
- Report to the MRM function on the related control KPIs feeding the key MR metrics (model materiality, model health, etc.)
- Verification that model risk mitigation requirements are in place

OPERATIONAL RISK MANAGERS

- Capture model risk events in the OR database events
- Report model risk events to the MRM function



To which extent model risk has to be quantified ?

Highlights of some responses provided by regulators

FED SR 11.7
(April 2011)

Model risk is to be evaluated and model validation plays a central role in this process, although they may not be a single and simple approach to model risk quantification

- "The banks should objectively assess model risk and the associated costs and benefits of using a sound model validation process".
- "Uncertainty and inaccuracies can sometimes be quantified, for example, by an assessment of the potential impacts of factors that are unobservable or not fully incorporated in the model or by the confidence interval around a statistical model's point estimate."
- "Accounting for model uncertainty may be done by explicitly adjusting model inputs or calculations to produce more severe or adverse model outputs. However, conservatism may become an impediment to model development and application and it can also leads model users to discount the model outputs."
- "Banks should justify and substantiate claims that model outputs are conservative (e.g. though sensitivity analysis, other types of stress-testing, judgmental and documented conservative adjustments, etc.)"
- "Another way in which banks may choose to be conservative is to hold an additional cushion of capital to protect against potential losses associated with model risk"

BCBS 277*
(Jan. 2014)

According to the BCBS, it is a good practice to set aside a capital cushion against model risk in the economic capital framework

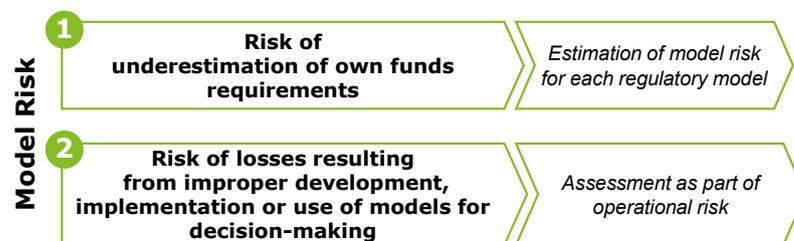
- "Several banks note the use of economic capital as another complementary view of a bank's condition... A bank employing this practice aggregates economic capital... and capital cushions for model risks..." (BCBS 277)
- "Economic capital provides banks with a common currency for measuring [risks]. The risks types that are typically covered by banks' economic capital models are [...] model risk

BCBS 152**
(March 2009)

The EBA's SREP guidelines emphasize that the Board and Senior Management should be aware of the degree of model risk. To account for model risk, a distinction is made between models used for regulatory purpose and those used for decision-making.

EBA's SREP
guidelines

(Dec. 2014)



- "... prudential use of models (e.g. "by increasing or decreasing the relevant parameters based on the direction of the positions")
- " For those business areas that make significant use of models, the competent authority should assess how significant the impact of model risk might be... through sensitivity and scenario analyses or stress-testing
- "The bank's management body and senior management [...] are aware of the degree of relevant model risk"

Supervision
in France

- **France Ministerial Order on risks and internal controls (Nov. 2014):** model risk is defined a sub-category of operational risk, which is subject to overall risk limits, risk measures and proper management information systems.
- **SSM:** model risk is partly gauged as part of the TRIM exercise (Target Review of Internal Models)

(*) Fundamental elements of a sound capital planning process, BCBS 277, Jan. 2014

(**) Range of practices in EC frameworks, BCBS 152, March 2009

Should model risk be quantified ?

A relatively new concept intertwined with already existing quantification requirements

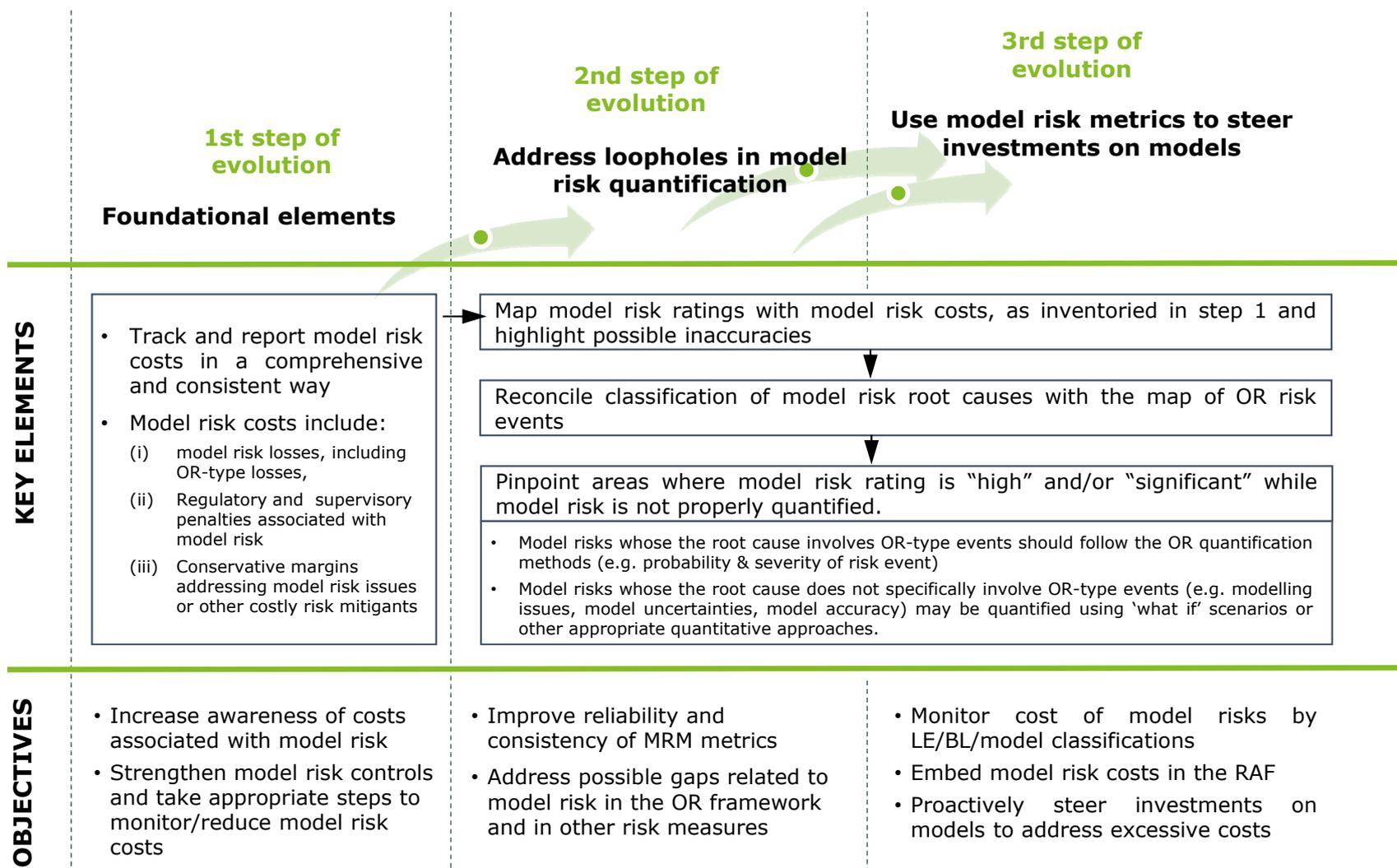
As a general principle, a certain proportion of model risk is already captured in the operational risk framework and through other pieces of regulations (e.g. prudent valuation, credit IRB models, etc.) in a piecemeal fashion.

However, some model risks (especially model uncertainties and inaccuracies) may not be already captured and when they may significantly impact a firm's profitability, they should be captured, if mitigants are seen as possibly not sufficient.

Sources of model risk		Prudent valuation	Accounting model reserves	Operational risks	Credit / Market internal modelling
		Fair-valued instruments	Exotic products, illiquid risk factors	AMA approach	Credit IRB models, market VaR models, CCR internal models
Data	<ul style="list-style-type: none"> Data quality and integrity Other data limitations: scarcity, use of external data, changes in definitions over time, etc. 			<ul style="list-style-type: none"> Data quality or integrity issues, leading to errors in decisions taken or information reported 	<ul style="list-style-type: none"> Conservative margins to tackle uncertainties or limitations in data
Modelling choices	<ul style="list-style-type: none"> Theory: non-standard or emerging model theory, un-tested limitations in the underpinning theories and assumptions, use of proxies Obsolescence, non-approved material changes Modelling complexities, misspecifications 	<ul style="list-style-type: none"> Model risk AVA : range of different models or model calibrations 	<ul style="list-style-type: none"> Model risk reserves due to limitations in modelling techniques 		
Model uncertainties	<ul style="list-style-type: none"> Scenario analyses: model behaviour in stressed or extreme conditions Sensitivity analyses: sensitivity to variations in input parameters estimations, to available data and to changes in assumptions Benchmarking analyses: comparison of outputs and theories to alternative modelling choices Stability & robustness: population stability, input and output stability, etc. 	<ul style="list-style-type: none"> Model risk AVA : range of different models or model calibrations 	<ul style="list-style-type: none"> Model risk reserves due to modelling assumptions or calibrations not appropriate to market conditions or other limitations in modelling assumptions 		<ul style="list-style-type: none"> Additional conservative margins may be required to tackle model uncertainties or deficiencies
Model accuracy	<ul style="list-style-type: none"> Backtesting: actual performance vs. past experience Discrimination power (if applicable) Range of validation techniques (incl. expert-judgments, reasonableness checks, etc.) 				<ul style="list-style-type: none"> Market risk: penalties for errors in backtesting
Model environment and use	<ul style="list-style-type: none"> Model infrastructure: (resources, systems / processes) Model governance: model challenges, permanent controls, on-going accuracy checks Model uses: uses differ from those initially intended Model interconnections: upstream and downstream dependencies to other models 	<ul style="list-style-type: none"> Operational risk AVA: operational risk related to valuation processes 		<ul style="list-style-type: none"> Misuse of models Model misoperation 	

Should model risk be quantified ?

Building an evolutionary model risk quantification framework



A progressive and evolutionary path for firms wishing to develop a model risk quantification framework.



SAS MRM

Introduction

Birame Fall, SAS 



MRM Project

Robert Rapacciuolo, TD Bank 



Round Table

Guillaume Figer, SG

Sophie Briot, BNP P

Guillaume Tabourin, BPCE

Hervé Phaure, Deloitte

Robert Rappaciuolo, TD bank

Renzo Traversini, SAS



Round Table :

Quantification & Technology

Q&A ON MODEL RISK ASSESSMENT FRAMEWORK

Q&A on SAS MRM experience sharing from TD Bank

MRM PROCESS MANAGEMENT & TECHNOLOGY

1. What are the main functionalities expected for an effective MRM solution ?
2. Should we consider that there are European specificities for this type of solution ?
3. How to manage multiple perimeters (Local VS Central) ?

OTHER TECHNOLOGIES TO SERVE MRM

4. Which processes could be automated through RPA (Robotic Process Automation) ?



Next steps

Nadège Grennepois, Deloitte 

Next steps

1. Key ideas discussed during the meeting will be shared with the participants and with the BUCF Technical Experts Group
2. Next Deloitte MRM event to be organized in September
3. A quick survey will be sent to gather MRM topics of interest for our next event
4. Please check our MRM website for any future news

<https://www2.deloitte.com/fr/fr/pages/risque-compliance-et-controle-interne/solutions/model-risk-management.html>



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