

Deloitte.



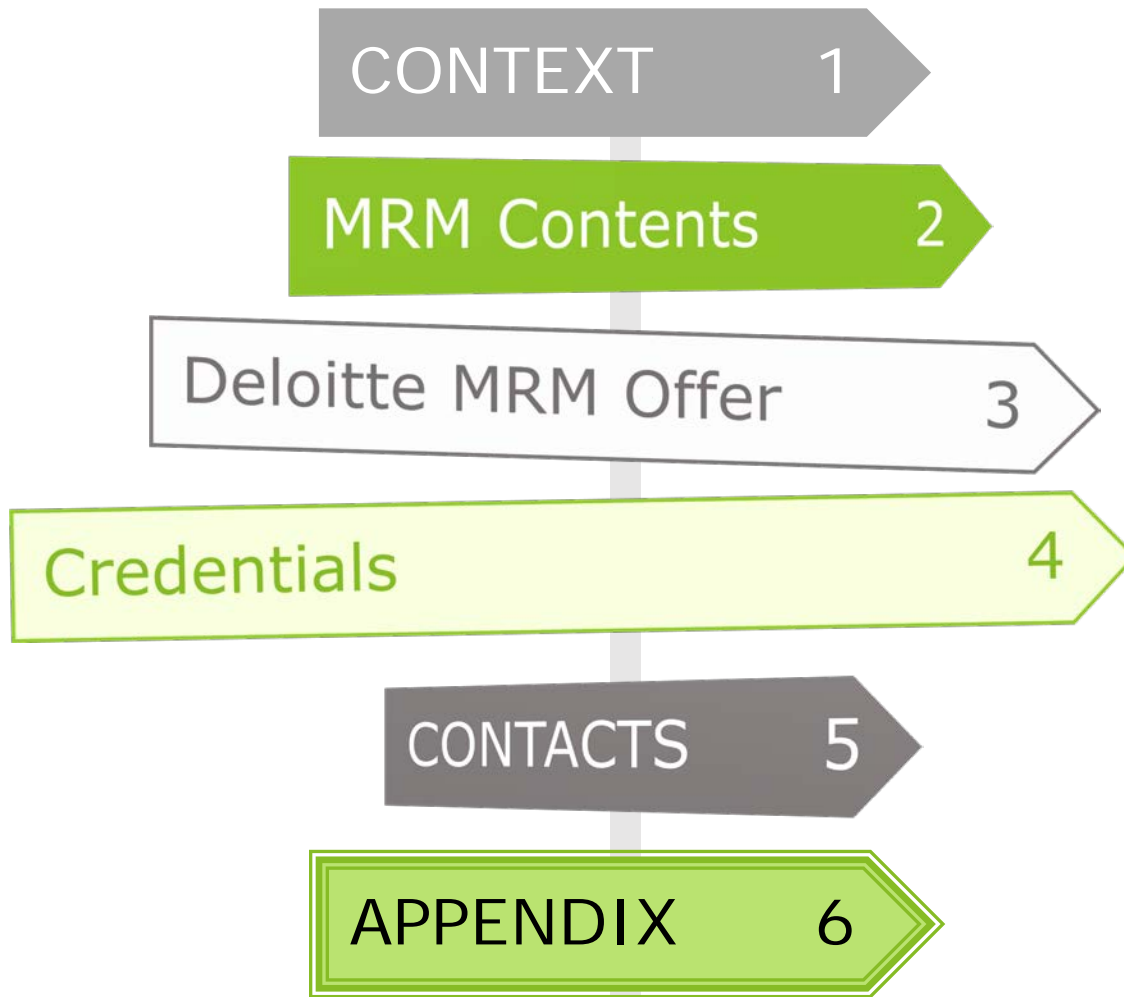
Model Risk Management

Driving the value in modelling

April 2017, Risk Advisory



Agenda





Part 1

Context



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"*.

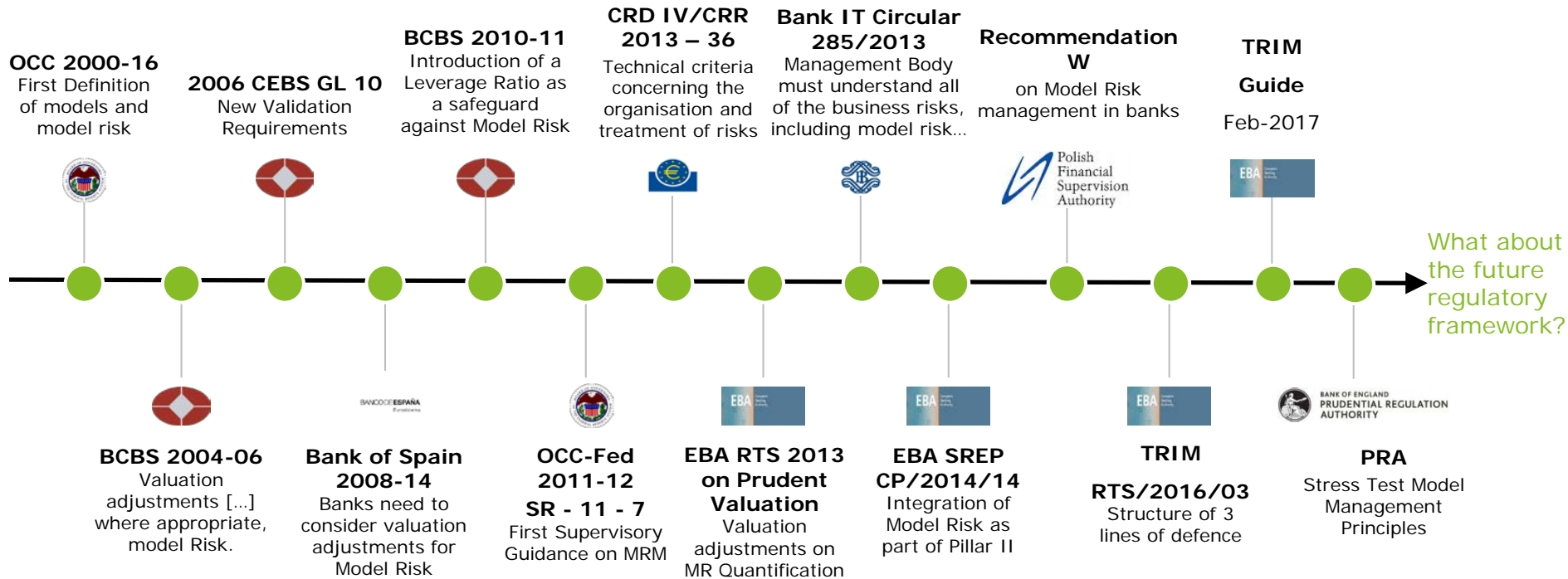
Market risk regulatory pre-crisis models

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.

Main regulatory references on MRM



SSM, EBA, ECB to focus their regulatory efforts on Model Risk Management framework.

Regulatory references in the EU

CRD IV / CRR



Defines Model Risk (Art. 3.1.11) and the process by which the Competent Authorities should assess how the institutions **manage and implement policies and processes to evaluate the exposure to Model Risk as part of the Operational Risk** (Art. 85).

Guidelines on SREP



The '*Guidelines on common procedures and methodologies for the supervisory review and evaluation process*' define the **main activities that the Competent Authorities should assess in the institution's exposure to model risk** arising from the use of internal models in its main business areas and operations. In particular, the Competent Authorities should consider to what extent, and for which purposes, the institution uses models to make decisions and its level of awareness (Management Body and Senior Management) of and how it manages model risk.

According to SREP Guidelines, the model risk can be **split into two distinct forms of risk with two different impacts risk profiles.**

	Form of risks	Risk profile
1	"Risk relating to the underestimation of own funds requirements by regulatory approved models (e.g. internal ratings-based (IRB) models for credit risk)"	"Competent authorities should consider the model risk as part of the assessment of specific risks to capital (e.g. IRB model deficiency is considered as part of the credit risk assessment) and for the capital adequacy assessment "
2	"Risk of losses relating to the development, implementation or improper use of any other models by the institution for decision-making (e.g. product pricing, evaluation of financial instruments, monitoring of risk limits, etc.)"	"Competent authorities should consider the risk as part of the assessment of operational risk " and it should be evaluated within this perimeter



Regulatory references in the US

The Federal Reserve and the Office of the Comptroller of the Currency (OCC) collaborated in publishing the Supervisory Guidance on Model Risk Management (OCC 2011-12/SR11-7), which has emerged as the **key regulatory guidance for model risk management and validation in the US** and lays out the basic principles for model risk management:

Governance, Policies and Controls

- Policy
- Model Definition
- Inventory
- Controls
- Roles & Responsibilities
- Documentation
- Model Risk Rating
- Model Risk Aggregation
- Change Control Process
- Effective Challenge
- Use of Vendors
- Stakeholder Credentials
- Life-Cycle Processes
- Regulatory Interpretation

Development, Implementation and Use

- Design Process
- Data Assessment
- Model Testing
- Documentation
- Model Limits
- Model Risk Rating
- Use vs. Intention
- Process for Programming
- Incorporating in Network
- Designing Controls
- Testing Implementation
- Documentation
- Model Error Process

Model Validation Process

- Validation Procedures
- Documentation
- Findings Resolution
- Nature of Monitoring
- Extent of Monitoring
- Frequency of Monitoring
- Recalculation procedures
- Conceptual soundness
- Outcomes analysis
- Sensitivity analysis
- Documentation
- Model Error Process

Impact of the New Regulations and Standards

• Impact FRTB

The FRTB includes updates to both the advanced and standardized models as well as stricter disclosure requirements and validation standards.

• Impact IRB

EBA Guidelines on PD, LGD estimation and treatment of defaulted asset as well as new default definition, conservatism margins, NPL assessment, rating process.

• Impact of Stress Testing

New stress testing methodology and principles defined by the PRA and EBA.

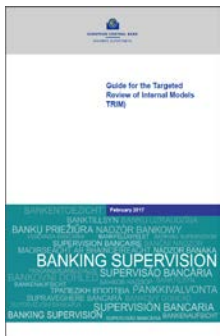
• Impact of IFRS9

The introduction of the IFRS 9 Impairments standard is demanding that banks use a new set of credit risk models; these models must be developed, deployed and maintained, which will literally double the number of Risk parameters models to manage.

• ECB TRIM Guide

The MRM framework should include:

- (a) A **model inventory** that allows a holistic understanding of their application and usage;
- (b) Guidelines on **identifying and mitigating** the areas where **measurement uncertainty and model deficiencies** are known;
- (c) Definitions of **roles and responsibilities**;
- (d) Definition of **policies, measurement procedures and reporting**.





Common expectations between TRIM and SR 11-7 US regulation (1/2)

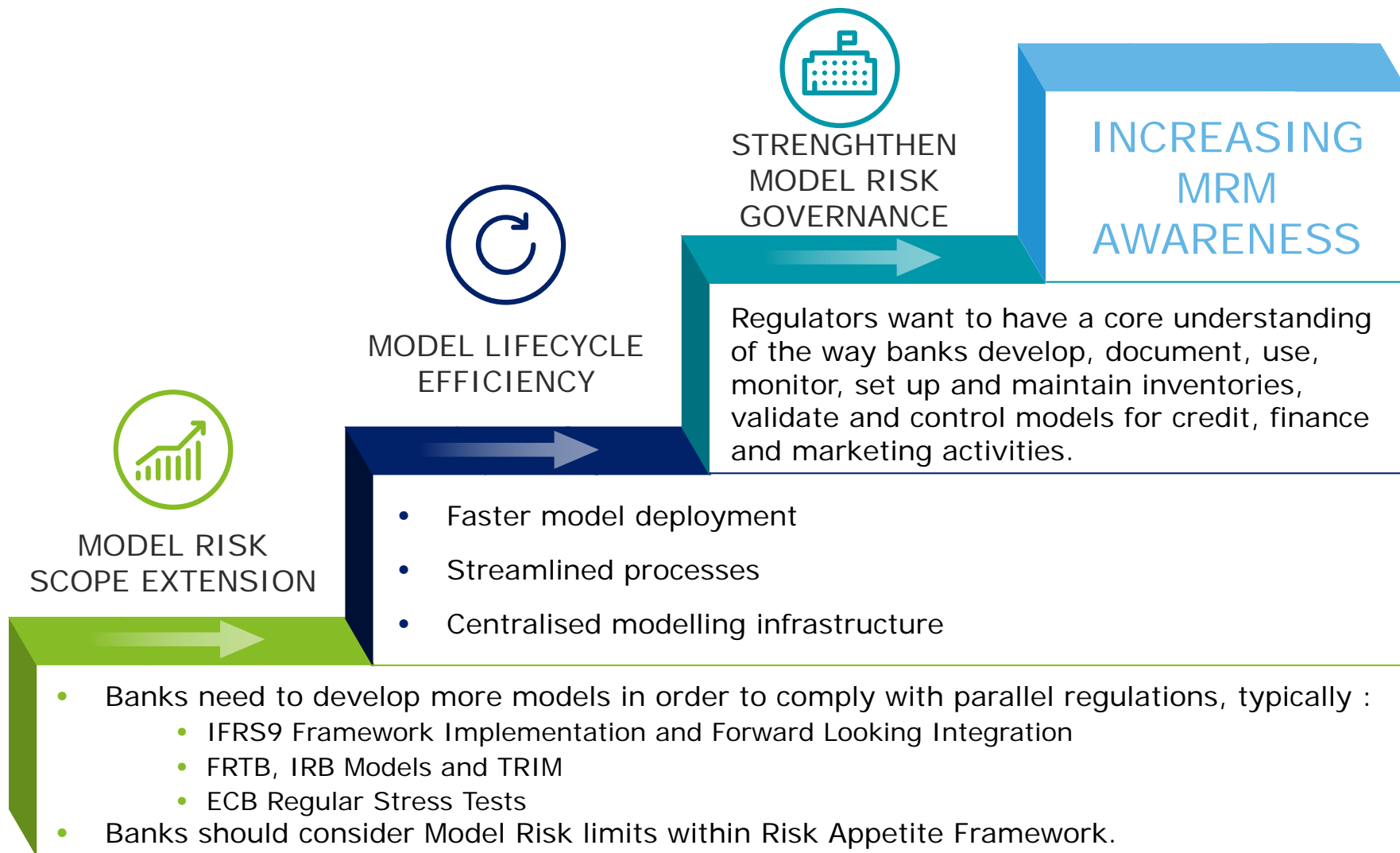
Topics as for SR 11-07		TRIM topics linked to MRM mentioned in the TRIM guide
Governance, policies and controls	Board of directors and senior management	<p>Proportionality principle is expected to be applied when reporting to the Senior management and management body for decision making.</p> <p>At least annually, both the senior management and management body should receive an aggregated overview of the validation results.</p>
	Policies and procedures	<p>Clearly defined policies approved by the Management Body and the Senior Management</p> <ul style="list-style-type: none"> - minimum risk management policies should be considered - clearly defined policy for model documentation - clearly defined policy for an adequate archiving and maintenance of the information, access permission, etc. - clearly defined policy for model validation and internal processes - clearly defined policy on the classification of changes done to a model (and that any arbitrage is avoided). - clearly defined policy on Data processing should be defined
	Roles and responsibilities	<p>Identify and differentiate the roles and responsibilities of the management body and senior management in the governance structure with regards to internal models and in relation to each risk type</p> <ul style="list-style-type: none"> - clearly state which individuals and/or bodies constitute the management body and the senior management. - clearly document the composition, mandates and reporting lines of committees responsible for internal model governance and oversight, as well as the decisions they take - the responsibilities of the senior management and the management body should be associated with the documentation, form, content of the process related to model approval process. <p>Institutions should have a dedicated independent data management unit with an overall view and responsibility for the management of data quality. Data ownership and data quality roles and responsibilities, should be clearly defined for both the business area and the IT unit.</p>
	Internal audit	<p>The institution should carry out a general risk assessment of all the aspects being subject to modelling at least annually. The compliance with all applicable requirements should be verified.</p> <p>The internal audit (or independent audit) should have a more important focus on areas showing sign of increased risk.</p>
	External resources	<p>It is expected that the institution maintain adequate internal knowledge of the outsourced tasks.</p> <p>The special case of delegating tasks, activities or functions related to the design, implementation and validation of the institution's models falls within the scope of, and should be explicitly set out in, this policy.</p> <p>If an institution plans to delegate tasks to a third party located outside the EU, it is encouraged to consult its Joint Supervisory Team (JST) in advance.</p>
	Model inventory	<p>Create an inventory of the model documentation with adequate controls.</p>
	Documentation	<p>The management body should be able to challenge the models outcomes, use, strenghts, limitations and this should be documented.</p> <p>The documentation should be kept up to date, taking into account the legal retention periods.</p> <p>Any activity associated with the internal audit (general assessment, prioritisation, work plan, audit techniques, guidelines, internal audit reports) are expected to be properly documented.</p> <p>Outcomes of the annual risk assessment is expected to be documented with regard to the use, the changes in the models, the quality of the data used for the models, the internal validation function and the process for calculating the funds requirements.</p>



Common expectations between TRIM and SR 11-7 US regulation (2/2)

<i>Topics as for SR 11-07</i>		<i>TRIM topics linked to MRM mentioned in the TRIM guide</i>
Model validation	Model validation (general)	The general validation process is expected to be consistent accross models, however the institution may take into account the specificities of the models.
	Evaluation of conceptual soundness	The institution should ensure that the validation unit has its own access to the relevant databases. The institution is extected to perform the validation exercice on a recurrent basis, at least at the initial validation.
	Ongoing monitoring	An ongoing monitoring should be done at least on an annual frequency.
	Outcome analysis	Outcome results should be presented to the senior management and to the management body and it is expected that the institution take into account the results throughout the model's lifecycle. Validation results for a model are expected to be aggregated and to be compared with the institution overall system. A summary report of all the models is expected to be produced.
	Validation of vendor products	Institutions should ensure that the external vendor products are developed in accordance with all existing regulatory requirements and with credit risk and counterparty credit risk internal principles. The institution should demonstrate a good understanding of the data cleansing process, assumptions used, methodological choices and subsequent limitations. It should also know and monitor the performance of the systems involved and have clear triggers for requesting a model change.
Model development, implementation and use	Model development and implementation	It is expected that institutions perform quantitative and qualitative impact assessment analysis on their models (changes operated on models). The institution should give a precise definition of the range of application of the models applied. It is expected Institutions to establish and implement an effective data quality framework. Institutions should perform regular IT implementation tests, from the data entry to the reporting stage.
	Model use	It is expected that banks continuously improve the accuracy and reliability of their risk parameters. It is expected that for a beneficial feedback loop there is a good understanding of the model, its assumptions and constraints and an adequate level of interaction between users, CRCU and internal validation.

Model Risk: the next risk type



MRM for better business decisions

- Banks are increasingly using decision models in their credit processes such as origination, limit management, collections and recoveries. In the commercial area, customers are able to select a product's characteristics and the system makes a real time decision on viability and price.
- Customer on boarding, engagement and marketing campaign models have become more prevalent for establishing customer loyalty and engagement actions in all stages of the relationship with the institution and at any time in the customer life cycle.
- Another area is fraud and money laundering detection.

Therefore, a clearly defined MRM framework with a strong management insight on monitoring models and their risks will allow institutions to **strengthen their decision making processes** and improve their **profitability**.

- 1 Access to **trusted**, quality models is essential to effectively using enterprise data – now considered a strategic asset – to drive better decision making and business results.
 - *Banks are heavily dependent on models to help them make the best decisions and navigate an increasingly competitive landscape. Banking executives, for example, are expected to rely on analytical models – not just gut instinct and experience – when making decisions about deploying capital in support of lending and customer management strategies.*
- 2 As limited expert resources are often an issue in financial institutions, it is important to handle existing resources in the most **cost-efficient** way.
 - *In order to achieve cost efficiency, model risk activities are prioritized and conducted for portfolios that are of higher importance, i.e. that contain strategically relevant positions with substantial position size, significant risk contribution or complex risk profiles.*
- 3 Model risk management should **add value** to the enterprise as well as reduce risk.
 - *Visibility into the source of data, confidence in the reliability and applicability of the model, and ongoing model improvements all support more effective decision-making for the organization, ultimately protecting its financial position and reputation.*



Part 2

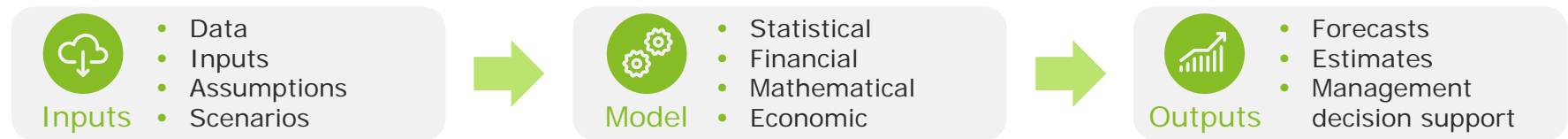
MRM Contents



Definitions

Model

A quantitative method* or system that applies theories to process input data into quantitative estimates for decision making (used repeatedly).



*Including also the complex manipulations of expert judgements.

Model Risk

Model Risk can be defined as the potential loss an institution may incur, as a consequence of decisions that could be principally based on the output of (internal) models, due to errors in the development, implementation or use of such models. (CRD IV, Article 3.1.11)

Model Risk Management Framework

Regardless of the organization's size and structure, regulators require that enterprise MRM frameworks encompass all relevant aspects of the MRM life cycle with clearly assigned roles and responsibilities:

- Model Risk Identification and Assessment,
- Model Risk Measurement and Mitigation,
- Model Risk Monitoring and Reporting.



Types of Models in the Scope

Comprehensive Model Coverage

A large global bank has a wide range of model types that are subject to governance and model risk management.

MODELS USED
FOR
« REGULATORY,
MANAGERIAL
AND
ACCOUNTING »
PURPOSES

Market and Liquidity Risk Models

- VaR (inc. Stressed VaR, IRC)
- ALM & Liquidity Risk
- Expected Shortfall

Credit & Counterparty Risk Models

- PD, LGD and EAD
- Risk rating models
- Exposure and CVA
- IFRS 9 Impairment

Operational Risk Models

- Loss Distribution Approach Model
- Integration Model

Compliance Models

- Anti-Money Laundering (AML)
- Anti Fraud
- Trader surveillance

Portfolio & Financial Risk Models

- Capital forecasting
- Stress testing
- Econometric models

Decision Support Models

- LOB models for customer targeting-marketing
- Credit underwriting
- Risk based collection models

Valuation & Pricing Models

- Derivatives
- Structured products
- Risk based pricing tools/models

Finance Models

- P&L Attribution
- Cash flow /NPV/Ratio Analysis

MODELS USED
FOR OTHER
PURPOSES

Marketing Models

- Marketing models
- Client Targeting

Insurance Models

- Actuarial models
- Loss Forecasting
- Reserving models

Investment Management

- Trading
- Security / Asset Pricing
- Portfolio Allocation

Other Models

- Corporate Finance Models (e.g. M&A, LBO, MBO)

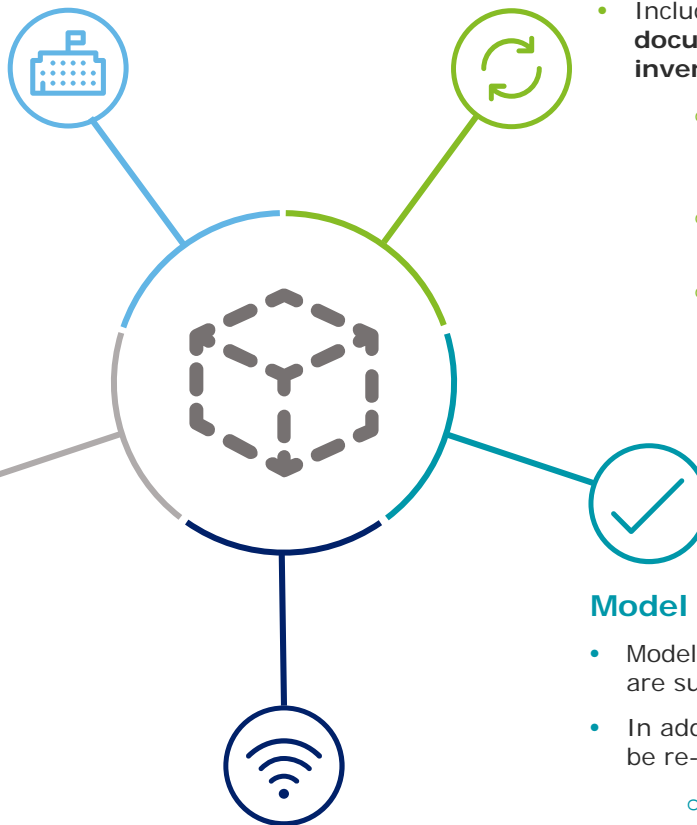
Elements of an objective MRM framework

Organisation and Governance

- Existence of a **Model Risk Management** that has been approved by the **Board**, who receive periodic **reports** regarding compliance.
- Existence of a **Model Risk function** that **reports directly to the CRO** and is responsible for the MRM framework and the governance.
- Existence of a model validation **function** responsible for the **independent validation of models**.

Model Risk Quantification

- **Quantitative techniques for model risk mitigation** (beyond regulatory requirements) regarding:
 - **Data**, sensitivity to errors or absence of variables;
 - **Estimates**, sensitivity of estimates (maximum impact, alternative models);
 - **Uses**, predictive power evolution, impact of erroneous use, etc.



Model Risk Management Processes & Technology

The MRM framework should be supported by optimized processes and a technological platform.

Model Lifecycle Management

- Includes the **model development, documentation, classification, inventory and follow-up**:
 - **Comprehensive inventory** covering all existing models and framework scope.
 - Models are classified according to the level of risk.
 - The documentation should include description, key variables, assumptions and algorithms.

Model Control Framework

- Models assigned the **highest level** of risk are subject to **continuous assessment**.
- In addition to the above, all models should be re-evaluated by Validation:
 - Annually.
 - If they undergo material changes.
- **Before they are deployed to production, they should have been approved.**

The Future of MRM: Approaching a Steady State

 1st

Line of Defence

Model Development / Use

- Complete ownership of Model Risk as an exposure class
- More robust and automated controls around model development and use
- Performing more vigorous model testing during the implementation phase
- Ongoing monitoring of models performance
- Post implementation and testing
- Introducing an IT infrastructure allowing for model user feedback

 2nd

Line of Defence

Model Validation / Control

- Expanding the Coverage of Models
- More focused on model validation rather than development (i.e. no co-development)
- Enhanced focus on efficiency (core teams supplemented by seasonal pools, and/or offshore resources)
- Efficiency through the use of technology platforms
- Introducing stricter controls and documentation standards

 3rd

Line of Defence

Internal Audit

- More focused on processes and controls
- Less focus on model-level content (e.g. mathematics, theory)
- More focus on the first line – development, documentation implementation & use of models
- Continuous / BAU instead of event-based
- Internal Audit Findings should be clearly documented and reported to Senior Management and the Board
- Assessment of the process for establishing and monitoring limits on model use



TRIM: A comprehensive framework to be set-up and will prepare further Model Risk Management implementation preparation

Model governance framework

- Definitions of roles and responsibilities for an effective Model Risk Management: board or "management body", senior management, model developers, model validators (2nd and 3rd lines of defence), model owners, model risk manager
- Organisation charts including external resources involved in the modelling and validation process
- Documentation of the composition, mandate and reporting lines of committees responsible for internal model governance and oversight, including decisions they take
- Guidelines on identifying and mitigating the areas where measurement uncertainty and model deficiencies are known. In particular the elements that relates to qualitative aspects of model risk. Define a consistent approach across the group for both central and local (subsidiaries).
- Model Risk management policies, measurement procedures and reporting
- Management of model changes including change policy, notification process, classification and responsibilities
- General principles for internal validation: validation policy, validation process and content

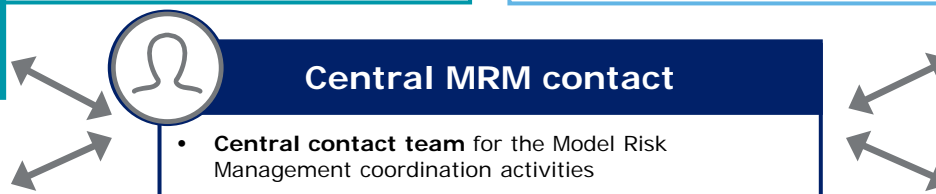
Tool: Organised online database and basic workflow management system

Model documentation

All models that are used for business decisions should be properly documented, the scope of the required documentation should be properly defined

- Model attestation
- Model normative framework
- Data quality reports: evaluation of input data
- Model development documentation including methodology and assumptions, instructions for model users and performance/validation (incl. the results of implementation testing), qualitative and quantitative analysis
- Model impact assessment
- Model validation reports (second line, third line, regulator)
- Model governance committees reports including decisions regarding the model
- Model backtesting and performance monitoring
- Model implementation, experience testing, user acceptance testing documentation

Tool: Organised shared online documentation database



Data and programs

- To ensure the overall coherence of deliverables for the review
- Collect all the data used for modelling, as well as all model performance indicators
 - Collect all the programs used for model development, validation and backtesting
 - Establish a central framework to store all data considered for use in the modelling process including
 - internal data
 - external data

Tool: Data and programs repository

Model inventory

- Comprehensive set of information for models implemented for use, under development for implementation, recently retired
- Definition of what constitutes a model
 - Allows a holistic understanding of model application and usage
 - Includes information about materiality of each model
 - Includes model stakeholders identification
- Register of model risk incident

Tool: Model inventory database and incident registry



Part 3

Deloitte MRM Offer



Deloitte MRM Offer

Deloitte proposed services

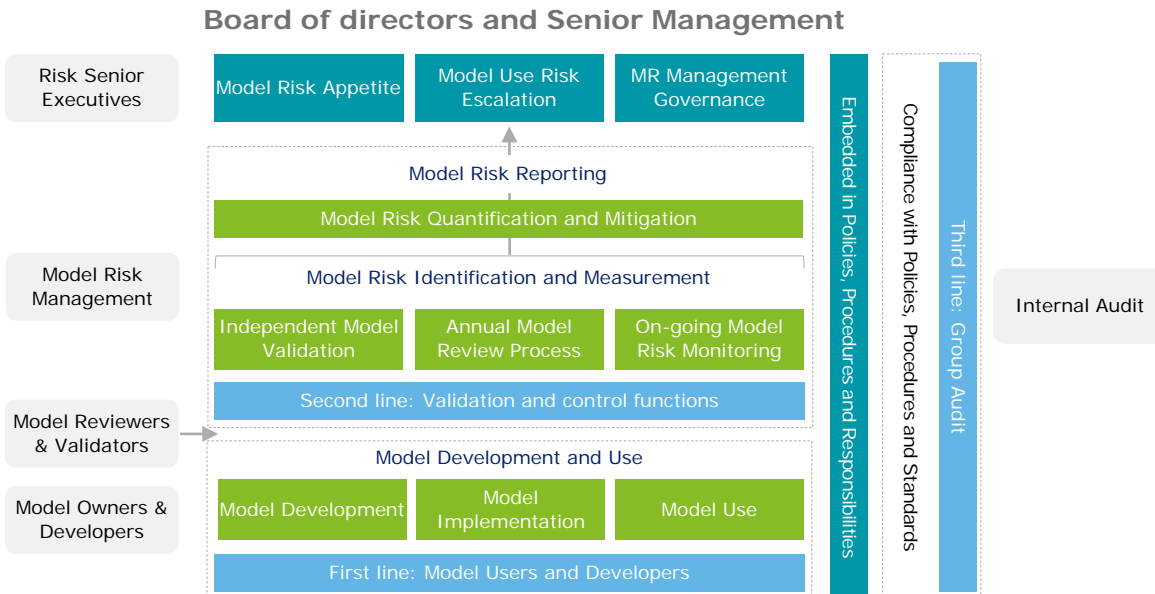
	<h3>ORGANISATION AND GOVERNANCE</h3>	<p>MRM Organisational Design : Role profiles according to the 3 lines of Defence, Internal Structuration, Outsourcing of some activities (model validation), Change Management, Creation and facilitation of MRM live training / e-learning modules, Peer benchmark assessment, Model Risk Attestation</p> <p>MRM Policy: Creation of policies, procedures, practices & controls according to regulatory guidance,</p> <p>MRM Program: Set-up effective MRM program, PMO activities</p> <p>MRM Governance: Define Model Risk Appetite, MR reporting, Guidelines for model usage and limitations</p>
	<h3>MODEL LIFECYCLE MANAGEMENT</h3>	<p>Model Inventory: Migration of multiple model systems into a single enterprise platform</p> <p>Model Classification: Assistance in classifying models (complexity, sophistication, materiality)</p> <p>MR Documentation: Standardized documentation templates including MR evaluation, Documentation review, Development of MRM life-cycle process flow charts with narratives</p> <p>Model Follow-Up: Design of reporting routines & ad-hoc reporting capabilities, Model Monitoring</p> <p>Model Assessment: Assessment of model implementation</p>
	<h3>MODEL CONTROL FRAMEWORK</h3>	<p>Data Quality Review: Model input data review</p> <p>Validation Approach: Design of appropriate model validation methodology</p> <p>Model Independent Review: Perform independent review and deliver model review report</p> <p>Model Control Process Optimization: Analyze and streamline the existing control processes, Design and adjust processes</p> <p>Model Risk monitoring: Model performance monitoring, KRI's and KPI's, Model Risk Appetite</p>
	<h3>MODEL RISK ASSESSMENT</h3>	<p>MRA Development: MR Source identification, Qualitative Assessment: Model Risk Scorecard, Quantitative Assessment: Model Uncertainty measurement, Model Risk incident database</p> <p>Model Risk Analytics: Sensitivity Analysis, Measuring MR impact on P&L and Capital</p> <p>Model Risk Mitigation: Identification of techniques for MR Mitigation</p>
	<h3>MODEL RISK TECHNOLOGY</h3>	<p>Platform Design: Set up & implementation of the MRM platform core functionalities & technology infrastructure, workflow process management</p> <p>Platform Selection: Assistance for choosing a MRM technological solution</p> <p>Data Quality Management: MRM data quality management for accuracy, consistency & completeness initiatives</p> <p>Automation: Automation of repeatable areas processes and activities (RPA)</p>

Structure Organisation and Governance

Deloitte can assist institutions with defining and implementing the MR functions and the associated governance within the organisations.



Model Risk Function should be independent of the other Validation, Audit and Model Development functions in the company.



- The **day-to-day management** of inherent model risk is delegated to the first, second and the third lines of defense.
- The **Board of Directors** is responsible for the approval of the MRM framework, receiving regular reports on the implementation of the MRM Policy.
- **External Resources** may be commissioned by banks to supplement internal capabilities for model validation and review, compliance functions, or other activities in support of internal audit or other lines of defence.

Source: Bank Risk Conference presentation in April 2015 by Konstantina Armata (Head of Global Model Validation & Governance at Deutsche Bank)



Structure Organisation and Governance

- ✓ 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.

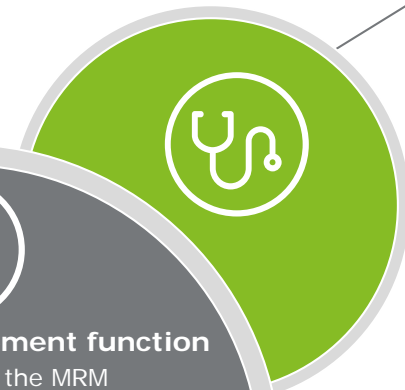
Model builders / model users

- 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



Model Risk Management function

- Create and maintain the MRM framework
- Maintain and update the inventory of models
- Design and promote implementation of model risk management policies
- Evaluate model risk to verify that it remains in the risk appetite boundaries
- Provide model risk reports to Senior Management and Board



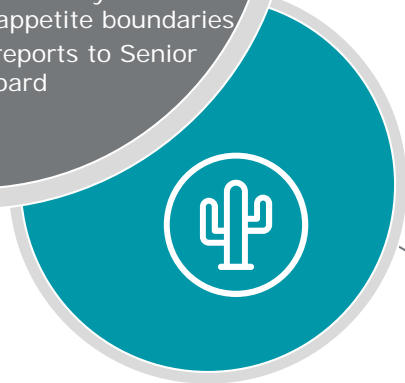
Three lines of defence

- 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

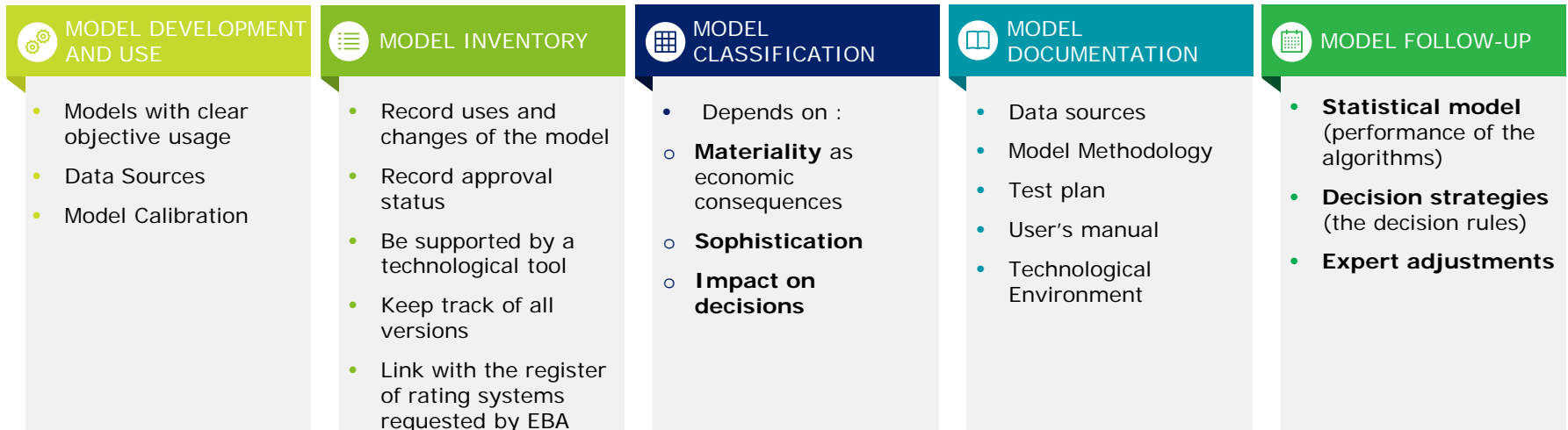
- Capture model risk events in the OR database events
- Report model risk events to the MRM function



Model Lifecycle Management

Our Model Lifecycle approach includes the following activities :

- **Model inventory** covering all of the organization’s models by type and goal;
- **Model classification and prioritisation** according to the risk posed to the bank, which will be required in the monitoring, validation and documentation of models;
- **Model documentation** requires a comprehensive documentation that provides evidence of the diligence used to create the model, captures the findings of the validation, and clarifies the intended use and limitations of the model;
- **Model follow-up scheme** for the early detection of both deviations from target performance and model misuse, in order to act accordingly.



The MRM should be assured by a **suitable tool that keeps track of all changes and versions of the models.**

Model Lifecycle Management

Inventory of the models supposes the detection of the perimeter of the models potentially impacted by the risk, through the identification of:

- **The type of model** (i.e. regulatory vs. model used for “managerial” or decision-making purposes)
- **The goal of the model** (e.g. risk management, budgeting, planning, product pricing, etc.)

Classification of the models according to the risk they bear, typically including tiers corresponding to high, medium, and low levels of model risk , based on certain criteria, or a combination of them :

MODEL CLASSIFICATION (TIERING)

- Model Materiality
- Model Complexity
- Model Impact
- Model Significance for enterprise decisions
- Availability of model Decisions
- Model Quality

VS

MODEL RISK PRIORITISATION

Definition of a ranking for the interventions on the models based on priority criteria on the main metrics.

Models inventory

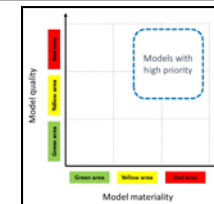
Models assessment

Models prioritisation



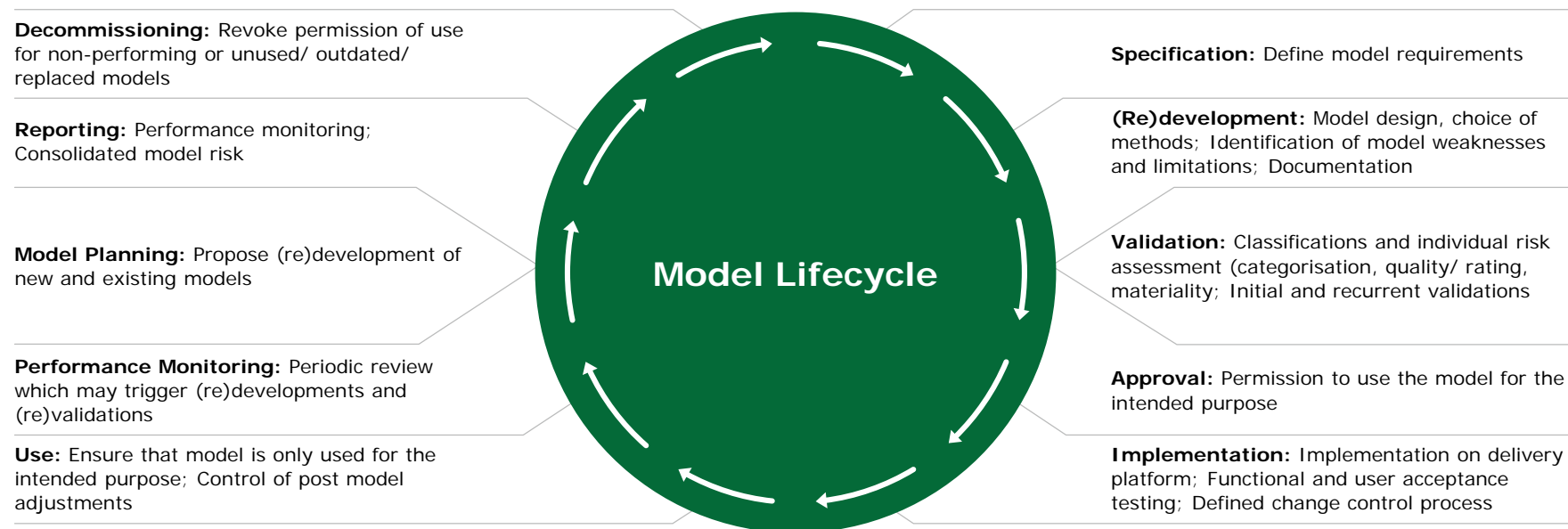
Model type	Model	Potential loss impact		Quality	Vintage
		Material	Non material	Performance	Years
Regulatory	Credit				
	Operational				
	...				
Used for managerial purposes	Credit				
	Planning				
	...				

Model Risk Identification

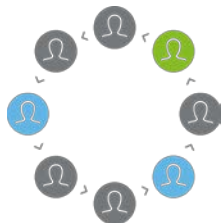


Model Lifecycle Management

Enhance the workflow efficiency through streamlined lifecycle management



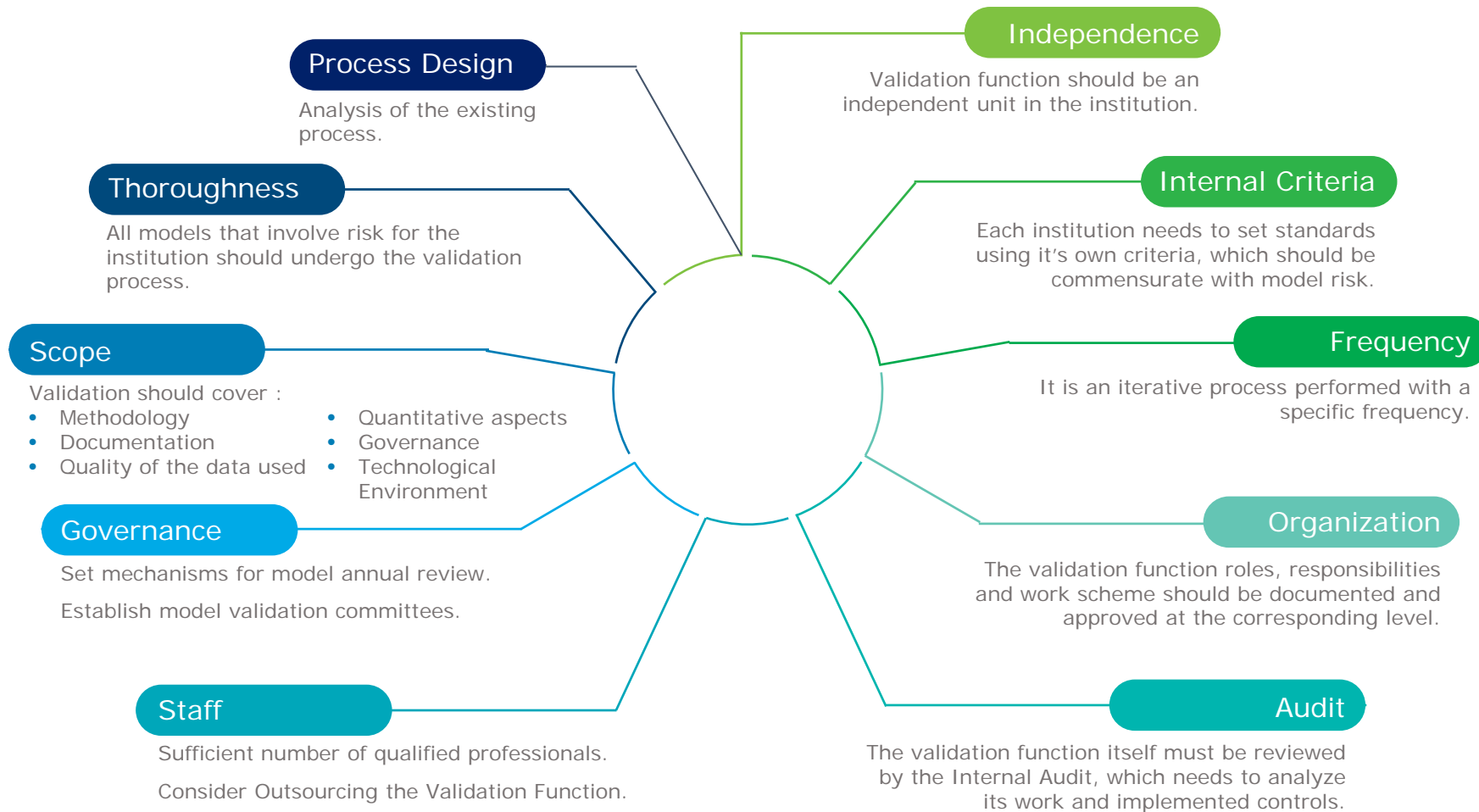
Workflow



- Role-based responsibilities at each control point in the workflow process
- Issue management and resolution
- Planning of resources
- Workflow oriented deadlines for each task
- Status reporting to the model inventory

Model Control Framework

The key part of a MRM framework is establishing a **strong and independent monitoring and validation function**. This function should be able to address the quantitative and qualitative review of models across the areas of data, methodology, documentation, processes and governance.





Model Control Framework

“Banks should have a more holistic approach to Model Validation. Not only the mathematics, but also the process and the data quality”.

INITIAL MODEL VALIDATION AND REVIEW

Validation KPIs and activities :

- Actual vs. Estimation analysis
- Stability Tests
- Discriminatory Power
- Concentration analysis
- Source Code Tests
- Sensitivity tests
- Benchmark tests
- Stress tests
- Convergence Tests
- Counter-checking with expert judgment

MODEL APPROVAL

Internal Model Approval Process:

- Model Approval requires the model validation to be completed
- Further approval from the senior risk and/or board risk committees

ONGOING REVIEW AND VALIDATION

Ongoing model validation and review are essential to assessing whether models are continuing to perform as expected new model limitations. Typically, model review and revalidation include :

- Material model changes
- Significant market changes
- Significant product or portfolio changes
- Change in the model risk ranking
- Backtesting
- Model performance deterioration detected by ongoing performance monitoring
- Regulatory and audit concerns



Model Risk Assessment

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 reporting

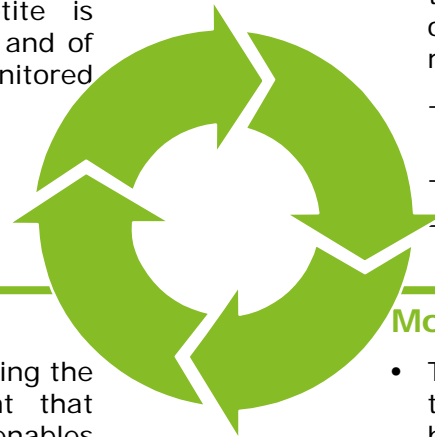
- The Board has ultimate responsibility for managing the firm's model risk. It is therefore important that information provided to the Board and BRC enables effective oversight of that risk:
 - Model risk profile against model risk appetite boundaries
 - Qualitative information (outcomes of model validation, 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 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 mitigation

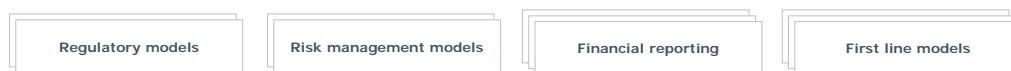
- To reduce exposure to model risk and to ensure the bank constantly operates within the boundaries of its risk appetite, model risk mitigants are to be prescribed when model health is weak or deteriorating:
 - A broad range of model risk mitigants are available depending on model types concerned, its 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.





Integrated Approach for Model Risk Assessment

- ✓ 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.



		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 risk rating	Model materiality			
	Low	Moderate	Significant	High
Very good	Green	Green	Yellow	Yellow
Good	Green	Yellow	Yellow	Yellow
Fair	Yellow	Yellow	Orange	Orange
Poor	Yellow	Orange	Red	Red

Illustration – Model Risk Quantification

SCENARIO OVERVIEW

Product/Client	Model	Risks
<ul style="list-style-type: none"> Scenario is aimed at analyzing and measuring the "Pricing Model Risk" relate to Forward Start Options for UE CIB 	<ul style="list-style-type: none"> Client counterparties (Market best practice) usually measure FwStart options market values with Heston model Client Murex release, do not include Heston model, thus option market price is obtained as a sum of two separate deals: <ul style="list-style-type: none"> One priced with Black&Scholes model, which generates a price different from the market one A dummy deal manually booked and calculated "out of the box" just to measure the difference between the B&S price and the Heston one The Heston value is obtained with external model (xls based) with manual input of main parameters 	<ul style="list-style-type: none"> Risks arise from model design - key measurement phase manually managed - and is related to manual input of parameters The loss could occur if there is a lack of the parameters' upgrade and in the same time, the counterparties ask the deal closing

QUANTIFICATION

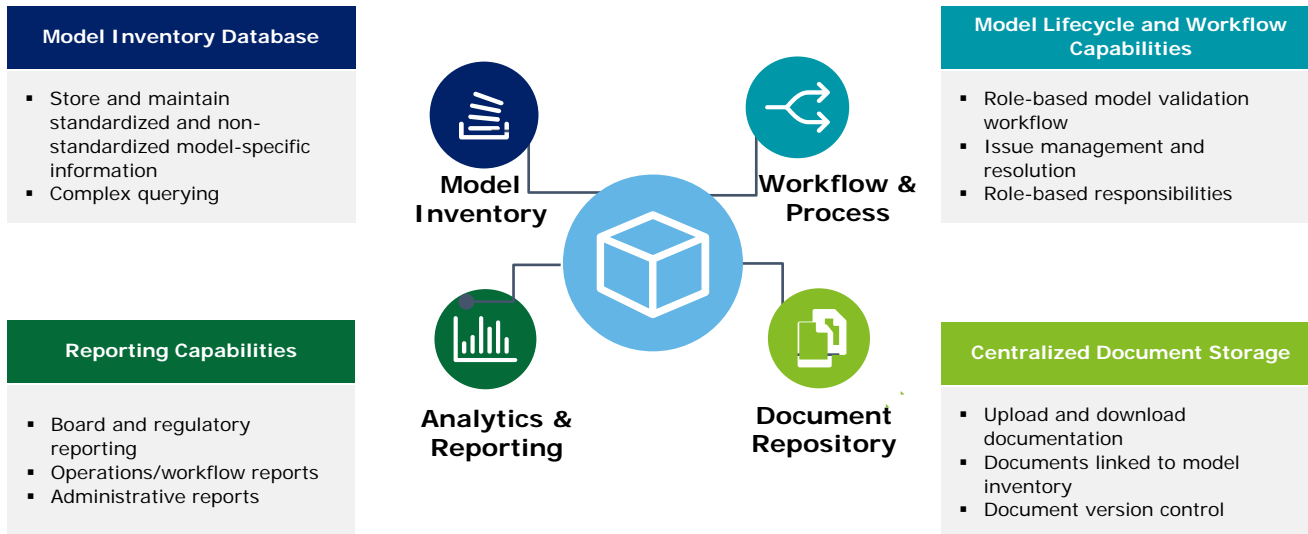
"Pricing Model Risk" is measured with a Statistical/Actuarial Approach (LDA) used for operational risk measurement, based on separate modeling of :

Frequency	Severity
<p>Count of the lack of recalibration, in the past 5 years, of the model's parameters and the early termination of deals, then the joint probability of occurrence</p> <p>Investigation about the occurrences in the past, with the aim to make a prediction for the next year analyzing budget volumes and expert opinions</p>	<p>Sample of potential losses: difference between the FWstart option price calculated with client model with no parameter recalibration and the FWstart market value</p> <p>Investigation about the most frequent impact and the worst one in the past, with the aim to make a prediction for the coming year, asking for confirmation to the experts</p>
	<p>As result of the analysis the costumer has decided to:</p> <ul style="list-style-type: none"> Evaluate the integration of Heston model directly, or of other models, currently not included in Murex Extend the existing controls for deals measured with Heston models

Model Risk Technology Capabilities

Banks utilize technology platforms to manage thousands of models in their inventory, with vendor solutions falling short. A solution shell can be customized and configured for the banks needs.

Key Features of MRM platform solution



Pre-configured **dashboards** for customized reporting



Several **use cases** specific to model risk life cycle



Robust **workflow capabilities** to track models, issues, and limitations



Extensible to all **three lines of defense**

Define Requirements

Design

Develop

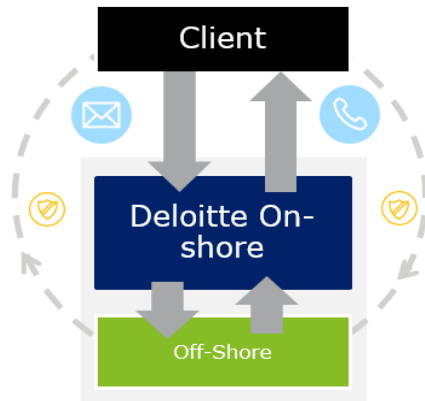
Test

Implement & Maintain

Off-shore support

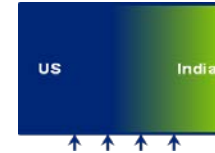
Driving “around the clock” progress and meaningful cost savings

Operating Strategy Benefits



- Deloitte professionals manage workload, communication and handoffs with off-shore resources, with no requirement for the client to interact with the off-shore team.
- The degree of direct communication and interaction between the client and off-shore resources can be customized to the client’s preference.

Degrees of Involvement



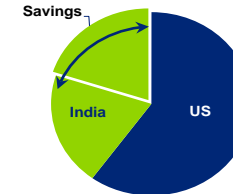
Degree of involvement is tailored based on complexity, type of models, and preferences.

Time Efficiency



Validation activities performed around the clock – 24-hour validation cycle

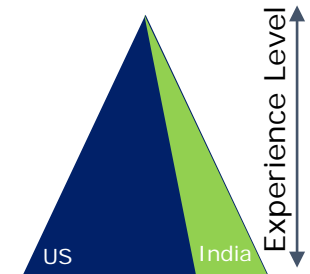
Cost Efficiency



Component of work in India leads to meaningful cost savings

Our Off-Shore Team At a Glance

- 150+ validation, MRM, data analytics, and quantitative modeling professionals
- Extensive experience with: Stress tests, Basel, Credit / Market / Operational / Liquidity Risk
- Programming skills include: SAS, R, Matlab, Python, SQL, C++
- A large, structured and leveraged team that includes a combination of senior resources with 5-10+ years of US experience leading staff teams with strong industry experience and educational credentials (economics / econometrics, math / statistics, and quantitative finance)





Part 4

Credentials



US Credentials

- Assistance to top 5 Banks with the enhancement of its MRM framework
- More than 100 professionals are helping or have helped the Bank comply with U.S. regulatory guidance related to models
- Project activities include MRM planning, model validation, technology enhancement, & process improvement

	<p>MRM PLANNING</p>	<p>Gap Assessment: Comparison of governance, practices, & controls to regulatory guidance Benchmarking: Analysis & presentation of the differences in industry practices for MRM MRM Program Design: Development of a multi-year plan for enhancing MRM</p>
	<p>MODEL VALIDATION</p>	<p>Staff Augmentation: 100+ professionals serving as an extension of the Bank's validation team Academic Research: Assistance with the creation of modeling "white-papers" Peer Review: Secondary review of internally performed model validations</p>
	<p>TECHNOLOGY ENHANCEMENT</p>	<p>Model Inventory: Migration of multiple model systems into a single enterprise platform Platform Development: Enhancement of the MRM platform & workflow, prototype development Data Quality Management: MRM data for accuracy, consistency, & completeness initiatives</p>
	<p>PROCESS IMPROVEMENT</p>	<p>Practice Development: Creation of MRM practices (e.g., Risk Classification Methodology) Reporting & Analytics: Design of reporting routines & ad-hoc reporting capabilities Documentation: Creation of policies, procedures, & standardized documentation templates</p>



EU Credentials

Mission name / perimeter	Project type	Details	Period	Country
Credit Risk	Internal rating system authorized by Local Authority	Updating of the Validation Framework for Credit Risk	4 months	Italy
	Internal rating system authorized by Local Authority	Support to Basel II Project PMO: management of the workstreams; coordination and communication to Directors and Corporate Bodies	LTS (project with an elapsed time higher than 2 years)	Italy
	Internal rating system authorized by Local Authority	Internal Rating System validation (using SAS), with focus on: PD models for Corporate and Retail portfolios LGD models for Corporate and Retail portfolios and LGD for Defaulted Asset Structured Finance models Models for Banks and Public Sector Entities portfolios Processes IT Systems II Pillar Risks	LTS (project with an elapsed time higher than 2 years)	Italy
Credit Risk	Internal rating system authorized	Development (using SAS) of the rating system: Support in development of PD, LGD and EAD centralized models for Corporate portfolio Personal loans, Mortgages, Salary Loans PD and LGD models development	LTS (project with an elapsed time higher than 2 years)	Italy
Credit Risk	Basel II roadmap in place	Internal Rating System validation (using SPSS), with focus on: Validation Framework PD models for Corporate and Retail portfolios LGD models for Corporate and Retail portfolios	LTS (project with an elapsed time higher than 2 years)	Italy
Credit Risk	Basel II roadmap in place	Rating system review: Internal Auditing Framework definition Quantitative aspects – Corporate and Retail models Organizational aspects/governance IT systems and Data Quality	LTS (project with an elapsed time higher than 2 years)	Italy
	Basel II roadmap in place	Rating system development: Defaulted Assets LGD model development EAD model development	LTS (project with an elapsed time higher than 2 years)	Italy
Operational Risk	AMA Development and validation	Review of Risk Classes for AMA capital calculation Support to validation of AMA calculation model Support to validation of AMA capital allocation methodology Support to Audit Unit on AMA process and validation calculation Support to AMA framework validation	LTS (project with an elapsed time higher than 2 years)	Italy



EU Credentials

Mission name / perimeter	Project type	Details	Period	Country
Operational Risk	AMA Design and Implementation	AMA framework designed by Deloitte for EIB resulted won the "European Operational Risk Awards 2006" for the category "Best AMA Framework of the year" during the OpRisk Europe Conference in London in 2006	4 months	Italy
Operational Risk	ORM framework development	Definition of methodology and validation instruments for ORM framework	7 months	Italy
Operational risk	AMA model validation	(i) stress-testing of the model under a variety of conditions, (ii) in-depth technical analysis of the code used by the client to compute the capital requirement and (iii) benchmark survey of the market practise of AMA models across 10 Deloitte member firms	2 months	Belgium
Counterparty Credit Risk	CVA model review for collateralized exposures	In the context of the Asset Quality Review, the National Bank of Belgium asked Deloitte to review the	1 month	Belgium
Credit Risk	Development a credit scoring model for acceptance of private loans	Development of a credit scoring model that is used to give a probability of default to consumer loans. The model uses logistic regression and is developed in R. The model can be used by the bank to assess the health of the current portfolio or the probability of default of new "through-the-door" customer.	6 months	Belgium
Market risk	Review of the valuation of complex equity swaps and interest rate derivatives	In the context of audit mandates within the Fund Industry, Deloitte reviews the valuation of complex equity swaps and interest rate derivatives by full revaluation using in-house built models (Black, Heston, Variance Gamma, SABR, Hull White).	6 months	Belgium
Market risk	Development of a valuation model for interest rate derivatives under the negative rate environment	Development of the shifted SABR model. The model consists of a calibrator that generates the SABR parameters and a pricer that uses the SABR parameters in order to price. The pricing covers most of the vanilla products, such as caps, floors, swaptions, CMS caps.	6 months	Belgium
Market risk	Model validation of a prepayment risk model for mortgage loans	Statistical analysis of historical prepayment rates across various clusters of clients and timeperiods. The institution is using this analysis as a back up to their expert-judgement	6 months	Belgium
Market risk	Review of the collateral haircut methodology	Review of the collateral haircut methodology	1 month	Belgium
Market risk	validation of a number of models used to value vanilla instruments (swap, FRA, swaptions, ZC inflation swaps)	Validation of a number of models used to value vanilla instruments (swap, FRA, swaptions, ZC inflation swaps)	3 months	Belgium



EU Credentials

Mission name / perimeter	Project type	Details	Period	Country
Market risk	Validation of the valuation model for a synthetic CDO	Validation of the valuation model for a synthetic CDO, including derivation of the default intensities from bond spreads; loss distribution and simulation based on Gaussian copula to generate the time to default.	2 months	Belgium
Credit Risk	Internal rating system authorized by Local Authority	Review of measures to solve regulatory findings	LTS (project with an elapsed time higher than 2 years)	Germany
Credit Risk	Internal rating system authorized by Local Authority	Validation of Corporate Rating Model (PD) (using SAS)	2 months	Germany
	Internal rating system authorized by Local Authority	Re-Development of Ratingmodel for Factoring including initial validation (PD, LGD, CCF, dilution) (using SAS)	LTS (project with an elapsed time higher than 2 years)	Germany
	Internal rating system awaiting approval by Local Authority	Support of rating model development for overdraft portfolio (PD, LGD, CCF) including initial validation. Additionally validation after first year (PD) (using SAS)	LTS (project with an elapsed time higher than 2 years)	Germany
	IFRS 9 Impairment model	Development of IFRS 9 impairment methodology including implementation of validation/Re-calibration process/methods	LTS (project with an elapsed time higher than 2 years).	Germany
Counterparty Credit Risk	Internal Model Method (IMM) authorized by Local Authority	Qualitative and quantitative validation of the stochastic processes, risk factors and dependencies including benchmarkings with historical data	4 months	Germany
	Internal Model Method (IMM) awaiting approval by Local Authority	Qualitative and quantitative validation of the market implied exposure simulation including independent implementation and exposure benchmarking	1,5 years	Germany
Credit risk	Support for the definition and the establishment of the Basel II IRBA project on factoring and leasing activities	<p>Project framework (Factoring & Leasing)</p> <p>Management and monitoring of Basel II project (governance project structuring, PMO, quality assurance, progressive validation of the approval file, skills transfer)</p> <p>Methodologies definition and risk parameters estimation :</p> <ul style="list-style-type: none"> o Framework – Review of the existing model and development plan definition o Model design <p>Model development within information systems</p> <p>Operational integration of model within process and organization</p>	3 years	France



EU Credentials

Mission name / perimeter	Project type	Details	Period	Country
Market Risk	Assistance in the approval process of the internal model	<p>Monte Carlo VAR - Assistance in the approval process by the French supervisor</p> <p>Cartography of the business lines / desks (type of instrument, P&L, risk limits)</p> <p>Writing of the model documentation provided to auditors and to the French supervisor</p> <p>Governance & Organization of the Market Risk department</p> <p>Market Risk monitoring : limits framework, model validation, reserves calculation</p> <p>Perimeter covered by internal model</p> <p>Monte Carlo VAR methodology : instruments re-pricing, scope of the risk factors, design of the scenarii, calibration of the correlation matrix</p> <p>IT architecture, workflow, definition of the controls to ensure the quality of the data</p> <p>Back testing framework</p> <p>Reportings (including stress tests)</p> <p>Follow up of the recommendations issued by the supervisor after its review</p>	6 months	France
Market Risk	Design of the Basel 2.5 framework : Stressed VaR, Incremental Risk Charge and Comprehensive Risk Measure	<p>Analysis of the regulatory directives and their application on the client's trading book (perimeter, risk measure, parameters, etc.)</p> <p>Cartography of the credit risk positions</p> <p>Implementation of risk measures, robustness tests and operational team training sessions</p> <p>Writing of the model documentation provided to auditors and to the French supervisor</p> <p>Follow up of the recommendations issued by the supervisor liaising with the stakeholders (FO, IT and Risk)</p>	2 years	France
Market Risk	Internal Model Approval - on site inspection	<p>Organisational structure : charts, sizing and roles of the involved departments (FO, Risk, Product Control, Finance)</p> <p>Governance around model changes & validation</p> <p>Model use & outputs : internal use of risk measurement system (including market risk management & limits setting), internal reportings, calculation of own funds requirements, capital allocation, stress testing</p> <p>Back testing process & results</p>	2 months	France



EU Credentials

Mission name / perimeter	Project type	Details	Period	Country
Credit risk	Independent audit of Credit Risk Model Management and Quality Control processes (Retail models)	<ul style="list-style-type: none"> - Review of the governance supporting Model Management, including maintenance, monitoring, model change management, back testing, use test and stress tests. - Review of the quality control in place that cover data quality management, internal credit risk reporting, calibration of risk parameters. 	3 months	Luxembourg
Credit risk	Independent validation of the CVA internal model	<ul style="list-style-type: none"> Critical analysis of the methodology Review of the process for calculating CVA Review of compliance to best banking practices 	3 months	Luxembourg
Credit risk	Independent validation of the LGD Retail model	<ul style="list-style-type: none"> Critical analysis of the methodology Review of the process for calculating LGD Review of compliance to CRD IV requirements 	2 months	Luxembourg
Credit risk	Audit outsourcing for Credit Risk Model (PD, LGD, CCF) and Market Risk Model Validation Processes	Review of the Model Validation life cycle, including Coverage, Governance, Documentation, Methodology and Maintenance of the Model Validation process.	3 months	Luxembourg
Credit risk	Independent review of IRB models for Corporate, PSE and Institutions counterparts (PD + LGD)	<ul style="list-style-type: none"> Four-year audit program covering all IRB models of the Bank (model and methodology, governance, use test) Benchmark against best banking practices 	4 months	Luxembourg
Market risk	Review and validation of the securitisation internal rating model	External, independent review of EIF's rating model with emphasis on the operating structure of the model and the model's underpinning assumptions and rating assignment mechanism.	4 months	Luxembourg



EU Credentials

Mission name / perimeter	Project type	Details	Period	Country
IFRS9	IFRS9 Risk Models	Development (using SAS) of the IFRS9 risk models: Support in definition and implementation of PD, LGD and EAD models for credit portfolios.	1 year	Spain
Credit Risk RDA Framework review	Data and processes review	Analysis of Business Processes supported in IT systems, according to RDA Framework, reviewing Source Data and Derived Data (calculations in loads, ETLs, transformations, etc.) for Credit Risk information.	1 year	Spain
Data issues Management	Data and processes review	Development of a methodology and an integrated tool to manage, from their identification to their solution, Data Quality issues for Credit Risk information.	6 months	Spain
Data Models review	Data and processes review	Definition and development of a Testing Plan and Controls over Data Models to ensure the correct functioning of consolidation and reporting engines (reconciling with general ledgers, error reviews, etc.) using IT solutions.	6 months	Spain
AQR review	Capital requirements	Support (using IT tools) of the analysis of Capital requirements under the AQR stress test methodology	3 months	Spain
Market Risk	Pricing Validation & Fair Value Audit	Development of Pricing Models to validate and audit the fair value of financial instruments (Level 1, Level2 and Level 3) using Montecarlo techniques, Gaussian Copulas, Black-Sholes among others..	6 months	Spain
Market Risk	Pricing Validation & Fair Value Audit	Development of CVA models to use them as a proxy for the validation of the credit risk adjustment reasonability	6 months	Spain
Market Risk	Pricing Validation & Fair Value Audit	Risk Sensitivity Analysis regarding risk model such as: liquidity analysis (inputs variations more than 95% of the standard deviation, quoted prices, bid/ask spread..), analysis of fair value impact considering changes in the key inputs (correlations, beta parameter, volatility due to market price uncertainty), close-out cost, CVA-FVA analysis.	6 months	Spain
Market Risk	Pricing Validation & Fair Value Audit	Validation of the whole internal control environment related to fair value process from the inputs capture to the accounting of the fair value	6 months	Spain
Credit risk, market risk, operational risk, model risk	Assessment on governance and control environment associated to all risks	Evaluation of the adequacy of the governance and control level established for the Entity All Risks (credit risk, market risk, operational risk, etc.) were under the scope, including model risk *Work methodology was based on the revision of written policies and procedures.	4 months	Spain



EU Credentials

Mission name / perimeter	Project type	Details	Period	Country
Internal Control Framework	Risk Control Function (RCF)	Assessment of the internal control framework and its compliance with EBA guidelines - Appropriate organisational framework and structure (independence and proportionality) - Composition, Responsibilities - Ensure there is a clear, transparent and documented decision-making process (reporting).	2 months	Spain
Internal Control	Support in the definition of internal control model and the SAP GRC system structure to manage it	Assistance in the definition of the internal control model in a systemic financial organization, based in the international standard COSO 2013:	1 year	Spain



Part 5

Contacts





Contacts

Please do not
hesitate to
contact your
relevant experts.

Marc Van Caeneghem

Partner
Global EMEA
+ 33 (0) 1 55 61 65 88
mvancaeneghem@deloitte.fr

Frédéric Bujoc

Partner
Valuation & Market Risk
+ 33 (0) 1 55 61 23 83
fbujoc@deloitte.fr

Hervé Phaure

Partner
Credit Risk & Operational Risk
+ 33 (0) 1 55 61 23 01
hphaure@deloitte.fr

Nadège Grennepois

Director
Credit Risk
+ 33 (0) 1 55 61 62 28
ngrennepois@deloitte.fr

Michel Guidoux

Senior Manager
Financial Risk Management
+ 33 (0) 1 55 61 66 90
mguidoux@deloitte.fr

Jean-Baptiste Olivier

Senior Manager
Valuation & Market Risk
+ 33 (0) 1 40 88 75 81
jolivier@deloitte.fr



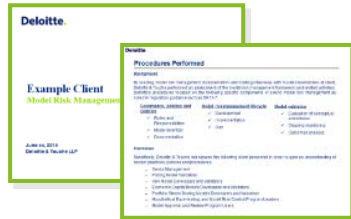
Part 6

Appendix



Tools & Methodologies

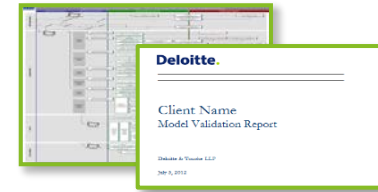
Validation Playbooks



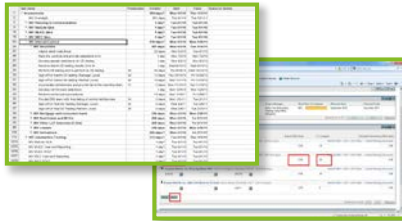
Validation Tools



Validation Templates



Project Management Tools



Training Materials



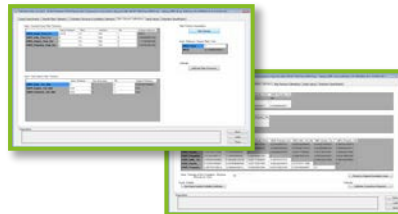
Reporting Templates



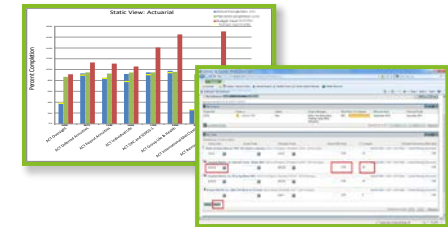
Risk Classification Methodology



Scenario Generators



Ongoing Monitoring Templates





About Deloitte

Deloitte refers to one or more of Deloitte Touche Tohmatsu Limited, a UK private company limited by guarantee, and its network of member firms, each of which is a legally separate and independent entity. Please see www.deloitte.com/about for a detailed description of the legal structure of Deloitte Touche Tohmatsu Limited and its member firms. In France, Deloitte SAS is the member firm of Deloitte Touche Tohmatsu Limited, and professional services are provided by its subsidiaries and affiliates.

Deloitte provides audit, tax, consulting, and financial advisory services to public and private clients spanning multiple industries. With a globally connected network of member firms in more than 150 countries, Deloitte brings world-class capabilities and high-quality service to clients, delivering the insights they need to address their most complex business challenges. Deloitte's approximately 244,000 professionals are committed to becoming the standard of excellence.

In France, Deloitte calls on diversified expertise to meet the challenges of its clients of all sizes from all industries - major multinationals, local micro-companies and medium-sized enterprises. With the expertise of its 10 300 professionals and partners, Deloitte is a leading player in audit, risk advisory, consulting, financial advisory, tax & legal and accounting, based on a multidisciplinary offering and a set of action principles attuned to the requirements of our environment.