Group Model Risk Standards

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Version Control Table

Name	Changes made	Materiality	Approved by	Version number	Approval Date	Effective Date
Martin Roberts	Initial Version	High	Julian Phillips	1.0	13 Dec 2018	
Mark Green	Principle based approach	High	Ian Anderson	1.1	28 Aug 2020	
Mark Green	1. Model issue management strengthened 2. AI & ML considerations 3. Alignment with Process Owners 4 Updated Inventory Section to reflect GAME fields 5. Clarification on SLA details 6 Model Sponsor Attestation	High	Jason Forrester	1.2	26 Apr 2021	
Mark Green	1. Link model scope to RTF and process for expansion 2. Further guidance on model identification process and governance of tools 3. Inventory field ownership 4. Optional tollgate process 5. Requirements for a developer to validator handover protocol 6. Guidance on rationale for validation outcome 7. Clarify planning and timing of revalidation & ASA processes 8. Clarify dispensation process for	Low	Jason Forrester	1.3	13 Dec 2021	

	unvalidated models 9. Specify timelines for identified concerns and immaterial issues 10. Further clarification on issue extension & closure processes 11. Further clarification on minor model change process 12. References to other applicable procedures					
Mark Green	1. Minor deviations to GMRP/GMRS 2. Timing of compliance with GMRP/GMRS changes 3. Model Developer role added as delegate to Model Owner with clarification of responsibilities 4. Maximum limit on Model Owner models owned. 5. Tollgates recommended for regulatory deliveries 6. Strengthen MFS requirements for BCBS 239 7. Clarification on expectations for vendor model development / validation 8. Clarification for documentation requirements for new models, model changes and revalidation	Low	Jason Forrester	1.4	21 Jun 2022	

	9. Introduce Issue life cycle 10. Separation of documentation issue management 11. Clarification of issue recording in GAME for non-MLC issues 12. Reliance on production IT controls 13. Model change governance 14. Model Sponsor decommission signoff 15. Guidance for Country Model Risk Governance					
Mark Green	1. Clearer model definition removing “critical/direct”. 2. Rebranded “qualitative framework” as “non-model estimate” 3. Replace BCBS239 data requirements with other model related data requirements from SS 1/23 4. Relaxation of 2 TDD / TVR template requirements for high risk/low risk. Single template will suffice but level of detail can vary with MRR. 5. Revalidation carve out for models with zero usage 6. 10 business days for issue owner	Low	Jason Forrester	1.5	3 Jul 2023	

	to provide action plan 7. Provisional approval process (renaming of previous mechanism) 8. ASA to include list of major model changes since time of last ASA 9. AI definition aligned with RAI and protected variables defined. 10. Governance of revalidation extensions 11. Introduce materiality factor for issue prioritization and revised risk acceptance criteria to be clearer 12. More flexible country governance requirements					
Mark Green	*Updates arising from SS 1/23:* 1. Model definition to include qualitative output and scope extended to include Recommendation Systems 2. DQM definition 3. Reference to Model Risk Capability Matrix (external document) 4. Tiering methodology: model purpose, reverify metrics. 5. Development requirements:		Jason Forrester	2.0	16 May 2024	1 June 2024

	DQ procedures, input data (unstructured, connected), operating boundary, in-model adjustments, vendor expectations, documentation standards, MRR data source 6. Validation requirements: review of items in 6. 7. Effectiveness of MRM and Validation 8. Approval: escalation process clarification 9. Implementation: UAT / UVT covering inputs, calculation, & outputs. 10. Monitoring: performance monitoring tests and procedures in MFS 11. Generalised Overlays section to Mitigants (in-model adjustments, PMAs, MA, Restrictions). PMA/MA requirements aligned to 1/23. 12. Model Change: requires pre and post change results. 13. Expanded ASA tasks: verify tiering methodology, suitability of production					

	environment, list of dispensations 14. Model Sponsor endorsement of dispensations, provisional approval and overlays for material models 15. Escalation to Model Sponsor on poor performance. *Other Updates:* 16. Inventory requirements removed and replaced by a link to confluence page 17. Frequency of revalidation for low-risk models 18. PMA validation binary outcome 19. AI/ML risks: governance vs validation flexibility.					

1. INTRODUCTION AND PURPOSE

This document operationalizes the Group Model Risk Policy ("GMRP").

1.1 Effective Date / Transition Period

After this Standard becomes effective, all derived Model Family Standards must be assessed against the new requirements and all required updates made and approved within 4 months of the effective date.

Certain model risk management activities will take time to be fully embedded after this Standard becomes effective. The following table details the perceived major impacts arising from this Standard change and associated grace periods (where applicable) for compliance.

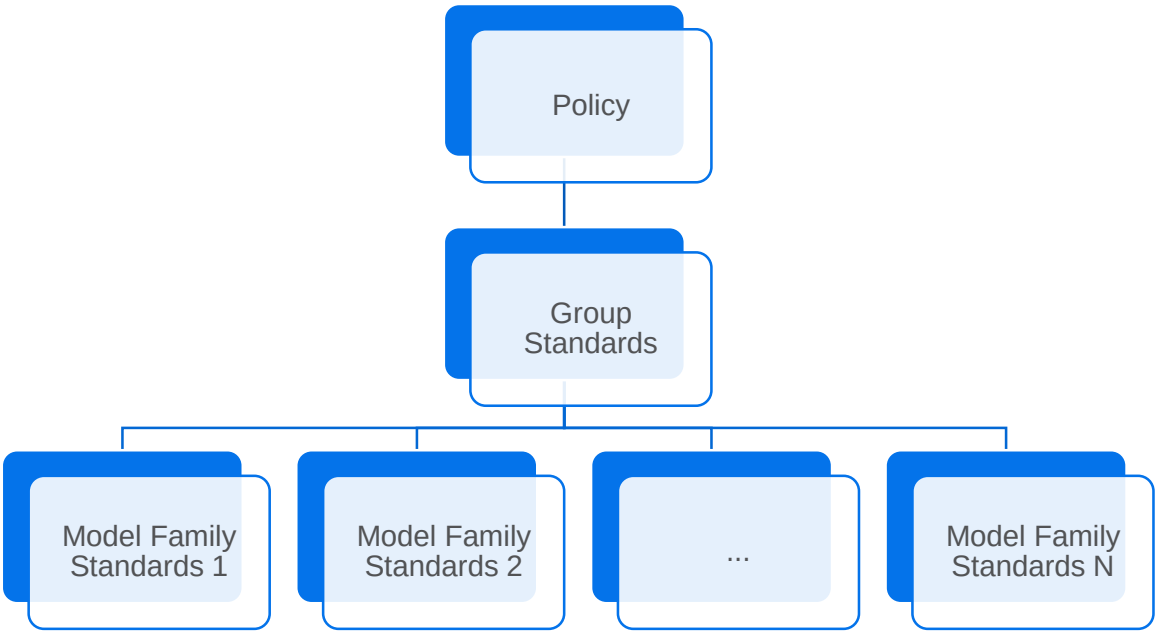
GMRP & GMRS Changes	Grace Period for Implementation
Expanded model definition with qualitative output	Zero (applies from effective date)
Application of materiality criteria from SS 1/23	Zero (applies from effective date)
Effectiveness of Validation	Zero (applies from effective date)
Extension of ASA process (list of dispensations, continued application of model overlays, assessment of tiering methodology of DQM)	Zero (applies from effective date) for inclusion of dispensations on a forward-looking basis. Aligned with DQM framework implementation for assessing tiering methodology.
Development Data Quality Standards	Updates to Model Family Standards to be documented and approved within four months[1] of the effective date of the GMRS, in accordance with the "SS 1/23 Roadmap to Compliance ("RTC")"
Changes to Performance Monitoring Process	
Changes to Mitigants Process (Adjustments, Overlays, Restrictions)	
Changes to UAT/UVT process requirements and System Process requirements (suitability) (Input feeds, Calculation accuracy, Output suitability)	
Inclusion Scope of Recommendation Systems	Timeline for compliance defined in the SS 1/23 RTC
Implementation of DQM Framework	Timeline for compliance defined in the SS 1/23 RTC
Developer Requirements	To be applied on a forward-looking basis for new models & applicable at the time of revalidation
Validation Requirements	To be applied on a forward-looking basis for new models & applicable at the time of revalidation

[1] Exceptions to this will be managed via the formal governance mechanism on RTC.

2. GROUP STANDARDS OVERVIEW

2.1 Model Risk Management Framework

The Model Risk Management ("MRM") framework used by the SCB Group is established as a three-tier framework as depicted below.



Document Type	Purpose
Policy	The GMRP states what things must be done (i.e., the requirements) and who is responsible (i.e., the roles). The GMRP is approved by Global Head, Enterprise Risk Management.
Group Standards	Group Standards state how things must be done to meet the requirements set out in the GMRP. These standards promote consistency of approach across the Group and are necessarily high level. The Group Standards are approved by Global Head, Enterprise Risk Management.
Model Family Standards	Model Family Standards state how things must be done within a given model family. Each model that is covered by the GMRP must map to a Model Family. Model Family Standards are approved by Global Head, Model Risk Management

Collectively the GMRP, Group Standards and Model Family Standards set out the MRM framework used by the SCB Group.

The GMRP and Standards are coordinated and administered by Model Risk Policy and Governance ("MRPG").

The effectiveness of the MRM framework will be assessed in line with Section 6 of the GMRP, including the Enterprise Risk Management Framework requirements for assessing Risk Type Frameworks and Policies, taking into consideration the end-to-end effectiveness across first line of defence ('1LOD') and second line of defence ('2LOD') roles as defined in the MRM framework.

2.2 Group Standards

This Group Standards document is organized into sections that broadly correspond to the GMRP sections. Each section provides background information of what the section covers and sets out the procedures of the tasks required to meet the GMRP requirements.

2.3 Model Family Standards

Model Family Standards augment and extend group requirements for application to specific model types and may expand on the policy requirements and are therefore more granular than the Group Standards.

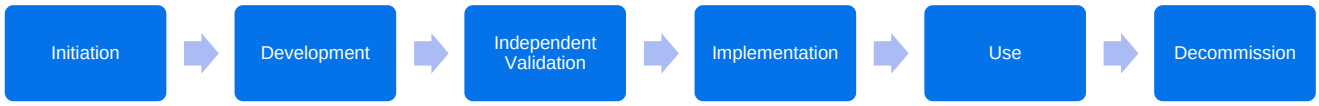
Model Family Standards will describe (as applicable):

- Model materiality definitions for the model family considering the nature of the models, for example what metric(s) are most appropriate to gauge materiality.
- Interpretation of model uncertainty guidelines for the model family, reflecting how they apply to models within a given model family.
- Depth, rigour and nature of development and validation work (documentation and testing) for the model type, proportionate to model risk rating.
- Development data quality management procedures in relation to the type of data used by the model family.
- Model approval hierarchy for the Delegated Model Approver of models within a given model family.
- Regulatory or external other requirements; procedures for obtaining external approvals.
- Monitoring standards, for example performance and misuse monitoring that are common to all models in the model family, taking into consideration the model risk rating
- Model change definitions (major change vs minor change) for the model family considering the nature of the models, for example likely frequency and type of changes.
- Implementation standards, for example specific approaches to User Acceptance Testing/User Verification Testing for models within a given model family.
- Model use control framework for models within a given model family.
- Minor deviations from GMRP and Group Standards.

The Model Owner (or delegate) and Group Model Validation (“GMV”) are responsible for documenting their relevant section of the Model Family Standards, for example GMV is responsible for documenting validation standards. Each Model Family Standard must be initially approved by Global Head, Model Risk Management, and when any changes are made.

2.4 Model Life Cycle

The Model Life Cycle ("MLC") is at the core of the MRM Framework and refers to the actions taken to manage model risk at individual model level. The MLC is the end-to-end process that a model goes through from initiation to decommission. The MLC consists of six stages:



A model version that has been initiated but is not yet live for use is referred to as "in-flight", whereas any model version that has gone "live" (i.e., released into a production environment and accessible to users) is referred to as "in-use", regardless of whether that model version has been used or not in a process – this distinction is monitored by "zero-usage".

The Group Standards set out principles for requirements that must be followed at each stage of the MLC. There are key outcomes which must be achieved at each stage of the MLC. The table below shows a typical end-to-end linear MLC flow with associated key outcomes arising through the cycle. It is also permissible for certain activities to occur in parallel, e.g., for models to be implemented in parallel with development or validation activities, as long as the go-live occurs after the approval date.

MLC Stage	Document(s) Required	Key Outcomes
Initiation	Terms of Reference ("ToR")	Model Owner assigned and initial Model Risk Rating proposed
Development	Technical Development Document ("TDD")	ToR has been signed-off
Validation	Technical Validation Report ("TVR")	TDD has been signed-off
Approval	Model Approval Request	TDD has been signed-off and TVR has been signed-off*
Implementation	-	TDD has been signed-off
Go-Live	-	Model has been approved and the User Acceptance Testing ("UAT") has been signed-off
Decommission	Decommissioning Plan	Decommissioning Plan has been signed-off Decommissioning evidence provided by System owner

*In exceptional circumstances models may be approved via provisional approval prior to completion of validation (or revalidation). See section 9 for provisional approval.

2.5 Role Holders

The role holders responsible for taking the model through its life cycle are defined as part of GMRP (Section 1.3) and Model RTF (Section 3). The Group Standards align to these responsibilities of the role holders as defined.

Throughout the Group Standards we refer to Model Owner and Model Sponsor extensively as the accountable executives for the design and implementation of the model, and the Model Users for whom the model is built.

While many tasks are assigned to Model Owner and Model Sponsor, it is recognized from a practical perspective that the individuals performing those tasks will typically be delegates. For example, delegates of the Model Owner could be a model manager for administrative tasks, or a Model Developer for development activities. A delegate of the Model Sponsor could be a COO for administrative tasks, or a Model User for testing purposes. This is permitted, and the accountability remains with the Model Owner and Model Sponsor, who are expected to provide the necessary level of oversight to remain comfortable with the delegation.

Certain tasks in the MLC will also involve Process Owners, who may be distinct from the Model Owner and/or Model Sponsor for some model types. For example, where model monitoring processes or model overlay processes are carried out by functions independent of the Model Owner or Model Sponsor.

More details on role specific expectations throughout the MLC can be found in the Model Risk Capability Matrix[2] (external document).

2.6 Templates

Standard templates are used for certain parts of the MLC, for example, Terms of Reference within the Model Initiation phase, Tollgate Templates for use within the Development phase, and Model Approval Templates for use in the Approval phase.

Technical Development Document ("TDD") and Technical Validation Review ("TVR") templates are also used and must address requirements in the Group Standards.

Other templates are available as guidance, for example a self-assessment template in relation to model identification, and a standard template for both TDD and TVR requirements (i.e., independent of any model family).

Templates are downloadable from a folder in the Model Risk SharePoint Site page accessible here.

2.7 Point of Contact

Questions about the Group Model Risk Policy and Group Model Risk Standards should be directed to MRPG: GroupModelRiskPolicy@sc.com.

3. IDENTIFICATION

3.1 Introduction

Models are simplified representations of real-world relationships. The expanding use of models in all aspects of banking reflects the extent to which models can improve business decisions, but this also comes with additional risk, such as the adverse consequences arising from using incorrect models or from misusing models. The starting point is identifying whether a given tool is a model.

3.2 Definition

Models are defined as tools that use assumptions and underlying theories to generate predictions or estimates. For the purposes of the GMRP, a model:

i. Consists of three components: an information input component which delivers assumptions and data to the model, a processing component which transforms the inputs into quantitative estimates, and an output component which translates the estimates into useful business information which may be quantitative or qualitative in nature.

[2] Available from 30 Sep 2024

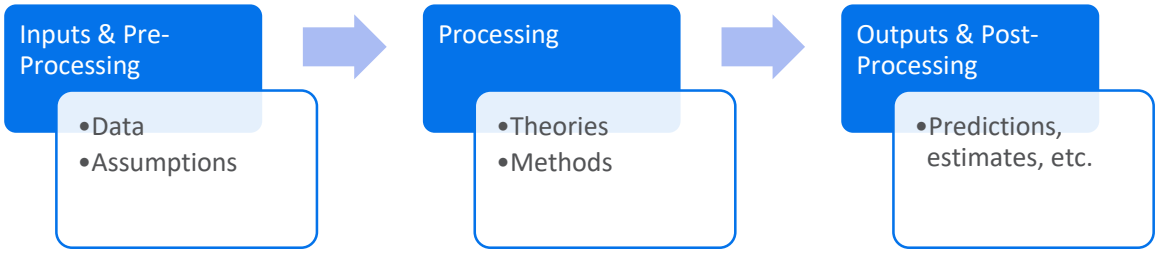
ii. Uses assumptions, underlying theories or techniques which are statistical, economic, financial or mathematical.
iii. Involves inherent uncertainty in relation to the model inputs, and/or processing unit and/or model outputs.
iv. Generates a quantitative or qualitative[3] output which is, or is planned to be, used as an input to a business decision making process, and not derived simply for information purposes.
v. Is used more than once (i.e., not one-time ad-hoc analysis).
vi. Is within scope of the Model Risk Type Framework ("RTF").

The definition of a model also includes quantitative approaches whose inputs are partially or wholly qualitative or based on expert judgement.

Inputs, Processing and Outputs

An end-to-end model solution consists of three components:

- Inputs & Pre-Processing. Inputs consist of data and assumptions. Model inputs may include outputs from other models. Pre-processing refers to converting raw inputs into useable information for the processing component to consume.
- Processing. A theory or method that converts the inputs into outputs. There may be one or multiple steps in the Processing component.
- Outputs & Post-Processing. Post-processing converts the raw model outputs into useable business information to meet the business requirements and delivering the final output to the end user.



A model consists of all components and steps required to generate the final modelled output required by the end user.

Tools that are used to transform inputs prior to use within the model, and tools that are used to transform or aggregate modelled outputs prior to transmission to the end user, are classified as part of the model.

Inherent Uncertainty

Inherent uncertainty refers to the uncertainty associated with a prediction or an estimate arising from the use of assumptions and/or theories. While uncertainty can arise in any or all the components, operational risks such as user error are not relevant when identifying whether a tool is a model.

3.2.1 Deterministic Quantitative Methods ('DQM')

DQM are defined as tools which meet the model definition in section 3.2, with the exclusion of requirement (ii), i.e., there is no use of mathematical, financial, economic theories or techniques to perform the processing (and hence no uncertainty arising from the choice of a given specific technique). DQM are often referred to as Non-Models ('NM') and the terms are used interchangeably.

[3] The core model output(s) can be subject to post-processing into non-quantitative form.

NM generally fall into two types, (a) Non-Model Estimations ('NME'), where the processing component is purely qualitative in nature (purely based on expert judgment) rather than quantitative, and (b) Non-Model Calculators ('NMC') where the processing component is purely deterministic, e.g., calculator arithmetic, logic trees etc. We use the term DQM to cover both purely deterministic calculations and those that are deterministic but with some expert judgement applied to the processing. The key differentiator between a DQM and a model is that DQM do not make use of any statistical, economic, financial or mathematical theories.

While DQM do not meet the formal definition of a model, they are still an integral part of a business decision process and are subject to governance requirements as specified in the Group DQM Standard. This includes requirements for the DQM Owner to register such Non-Models in the Group DQM Inventory, documentation, implementation testing and management control requirements. In addition, where such DQM have a material bearing on business decisions and are complex in nature, consideration should be given as to whether certain aspects of the MLC should be applied (e.g., validation, monitoring, etc.).

For any question relating to DQM please contact MRPG for clarification at GroupModelRiskPolicy@sc.com.

3.2.2 Analytic Tools

An analytic tool is defined as a tool that meets the model definition in section 3.2, with the exclusion of requirement (iv). The output produced by the tool is not, and not planned to be, used as an input to a business decision process.

It is not uncommon for something initially classified as an analytic tool to transition into a model (or DQM) due to increased reliance as part of a decision process. For example, where a tool is initially used for indicative benchmarking and transitions to become the model (or DQM) of choice driving the decision process (e.g., transition from challenger to champion model). Where an analytic tool is expected to become a model (or DQM) in the future, a suitable governance process would include monitoring the importance of the tool in the decision process and defining and agreeing a threshold with MRPG above which the tool is subject to the model framework requirements.

Where the determination of an analytic tool as a model (or DQM) is unclear this should be escalated to MRPG at ***GroupModelRiskPolicy@sc.com*** for confirmation.

3.2.3 Single Use Tools

A single use tool is defined as a tool that meets the model definition in section 3.2, with the exclusion of requirement (v), such that it is not used repeatedly.

On occasion it may prove necessary to perform bespoke analysis that will only be applied on a one-off basis. A tool that is used for the purpose of such one-time analysis will not be treated as a model, and does not require documentation on a TDD, validation in a TVR or recording in the model inventory. However, such analysis must still be subject to review and challenge by subject matter experts, which could include GMV with regards to any technical details. The owner of the single use tool is responsible for ensuring there is a suitable review and challenge process in place to govern the usage of the tool.

Note, this only applies to single use tools. Where a tool is used repeatedly and meets the definition of a model (or DQM), it will be classified as a model (or DQM) and is required to meet the relevant framework requirements. For any question relating to single use tools please contact MRPG for clarification at GroupModelRiskPolicy@sc.com.

3.3 Checklist

The following checklist should be referenced to self-assess whether a give tool is a model. Model candidates need to meet all six criteria.

CHECKLIST: MODEL IDENTIFICATION		
ITEM	CRITERIA	COMMENTS
1	Consists of three components – 1. Input, 2. Processing, 3. Output	Most tools will satisfy this basic construct.
2	Processing component uses assumptions, underlying theories or techniques which are statistical, economic, financial, or mathematical	For example, any form of simulation (e.g., Monte Carlo) or projection, risk-neutral derivative pricing, interpolation, extrapolation, and filtering techniques are all models. A purely expert judgment rules-based approach does not constitute a model but would qualify as a DQM. Similarly, a purely deterministic processing component would not constitute a model but would qualify as a DQM.
3	Involves inherent uncertainty in relation to the model inputs, and/or processing unit and/or model outputs.	For example, a simple deterministic calculator with no assumptions is not a model but would qualify as a DQM. Uncertainty can occur in the input (e.g., lack of observable data), processing component (e.g., choice of algorithm used), or final output (e.g., standard error, numerical accuracy, confidence interval). The presence of operational risk is not a determining factor of model classification.
4	Output is quantitative or qualitative and is used as an estimate or predictive metric which is, or planned to be, used as an input to a business decision making process	For example, output produced for information purposes only with no usage as part of a business decision process is not a model.
5	Tool is used more than once	For example, one-time analysis performed in support of a business decision or overlay will not be considered as a model.
6	Is in scope of the Model RTF	The Model RTF defines a set of model families defining the scope of application of the model definition used to construct the model universe population within SCB.

Where the determination of a tool as a model is unclear, a Model Identification Assessment should be submitted to MRPG, at GroupModelRiskPolicy@sc.com to facilitate a decision. Respective subject matter experts in GMV are to be consulted in this assessment process and the Policy Owner has ultimate authority to determine if a tool is a model and whether it falls within scope of the Model Risk Management Framework.

If the tool is determined to be a model and within scope of the Model Risk Management Framework, then the Process Owner should (1) check if the model is already recorded in the Global Analytics Model Explorer (GAME) and (2) check whether GAME records their Process as approved to use the model.

If the model is not recorded in GAME: • Identify Model Sponsor • Model Sponsor appoints Model Owner • Model is recorded in the GAME • If model is already in-use, a dispensation request for continued use is required unless provisional approval has been granted.	If the model is recorded in GAME but the model has not been approved for use in that process: • Contact Model Owner to initiate addition of the model to the process • Make dispensation request for continued use

3.4 Additional Guidance

Model identification is determined using Section 3.2; the following is provided for additional guidance only:

	Example	Comments
1	Regulatory prescribed factors	Where a regulatory prescribed factor is based on application of a rules based regulatory formula or where parameter values are specified directly, and where there are no additional modelling assumptions, this does not constitute a model for SCB purposes, however it may meet the definition of a DQM. The fact that a regulatory prescribed factor is not a model does not remove the need for operational controls to ensure correct selection and use. For DQM that are complex in nature with material impact on business decisions, consideration should be given as to whether to apply aspects of the MLC (e.g., validation). Where a regulatory prescribed value is taken as an input into an SCB model then the value must be assessed for reasonableness in the same way that an internally generated input would be assessed. Where additional modelling assumptions are required to deduce a value of the regulatory factor (e.g., distributional assumptions) the calculation would be classified as a model.
2	Regulatory prescribed algorithms[4]	Where a regulatory prescribed algorithm is a prescribed calculation with no additional modelling assumptions, it is not viewed as a model for SCB purposes. However, it may meet the definition of a DQM. Internal models may be used to generate inputs to the regulatory algorithm, in which case the algorithm is the end-user and those inputs must be designed and tested to meet the end user requirements. The fact that a regulatory prescribed algorithm is not a model does not remove the need for operational controls to ensure correct selection and use, and in some instances (e.g., where the DQM is complex with a material impact) an independent review may be required, in accordance with the Group DQM Standard.
3	Financial projections	Projections are predictions with uncertainty arising possibly from the choice of processing component (e.g., Monte Carlo, regression choice, etc.), or from the inputs used within the model (e.g., choice of macro-economic drivers) and are therefore usually models. If the projection was based solely on expert judgement this would meet the definition of a DQM and be subject to the Group DQM Standard.
4	Aggregation tools	Where aggregation tools are used to combine uncertain inputs as part of the end-to-end model solution (with possible intermediate model-based calculations) the final aggregation would be viewed as a model.

[4] Even when regulatory prescribed calculations do not meet the definition of a model, there might be a reason to perform a validation review (e.g., due to regulatory expectation, or implementation risk arising from complexity). This should be treated on a case-by-case basis – with Group Model Validation making the final decision.

	Example	Comments
		Where there are stand-alone aggregation calculations (e.g., summing of two model outputs), this would not generally[5] be considered a model unless the aggregation introduces additional uncertainty. If the aggregation approach is regulatory prescribed, for example the RWA algorithm, EL calculation or LCR ratio, then the aggregation method would not typically be classified a model. However, in both cases the aggregation may meet the definition of a DQM and be subject to the Group DQM Standard.
5	Ranking tools, Filtering tools	Tools that organize data are not models if they are not used as an estimation.
6	Descriptive metrics	Standalone calculation of descriptive measures, for example mean, mode, variance, range, etc. of a data set, are not models. Note that if they are used as inputs into a model then they would form part of the end-to-end solution.
7	Measurements	Tools used to measure or produce actual values are not modelled predictions if there is no room for error arising from inherent uncertainty and are therefore not models.
8	Model Monitoring	Some monitoring tests can constitute models, for example some methodologies used to calculate backtesting exceptions.
9	Model Overlays	Methodologies used for Post Model Adjustments ("PMAs") can constitute models, for example where the PMA itself is computed as the result of another benchmark model. Management adjustments are not models if the processing component is expert judgement based, however these would be classified as DQM and subject to the Group DQM Standard.
10	Expert Judgement	Pure expert judgement is not a model (and regardless of whether the expert is provided with information on which to make that judgement, although the information provided may itself constitute model output), however such expert judgement processing would be classified as a DQM and subject to the Group DQM Standard. Constrained expert judgement – where a processing stage is used to weight, combine, and convert expert judgement into a quantitative output – is likely to be a model.
11	Single Use Tools	Where a piece of analysis derived from a tool is used only once in support of a business decision, it will not be treated as a model but is still subject to review and challenge requirements.

The following are <u>not</u> relevant for model identification:

Factor	Comment
Whether inputs are quantitative or qualitative	A model can convert both types of data into an output component
Whether outputs are quantitative or qualitative	The output component may be quantitative or qualitative. Typically, where the final output is qualitative, there is usually a translation layer converting quantitative output into a qualitative form.
Simplicity or complexity of the processing component	Model risk increases with the complexity of the algorithm however it is not relevant for determining the status of a tool as a model.

[5] While such deterministic stand-alone aggregation tools are not usually models, there may be occasions that warrant an independent review e.g., where they are of sufficient complexity to carry heightened implementation risk, and/or are part of a regulatory calculation. This should be considered on a case-by-case basis in accordance with Group DQM Standards.

	Complexity can be used as a determining factor for a DQM to determine if it warrants application of aspects of MLC requirements in accordance with the Group DQM Standard.
Whether the model output can be explained or not	For example, methods used by Artificial Intelligence engines may not be transparent and hence the Model Developer or user may not be able to fully explain the model output (this is better viewed as elevated model risk from using the model rather than it not being a model).
Whether the output of the model is considered “good” or “bad”	The level of uncertainty associated with the model is assessed during development and validation and gauged using the uncertainty rating.
Number of assumptions and sophistication of those assumptions	The nature of the assumptions influences the amount of model risk but the fact that assumptions are used means that there is uncertainty in the final output.
How the tool is deployed e.g., ITO solution, EUC, Excel, etc.	A delivery system is not a model. A delivery system can contain models and/or DQM. There may be heightened risk associated with non-production systems e.g., EUCs / Excel.
Materiality and Use of the Model	These may drive the intensity and frequency of model risk management activities but are not relevant to the classification of a tool as a model. The impact of a DQM on a business decision process along with its complexity is a deciding factor on whether to apply additional MLC requirements to a DQM.
Whether operational errors can arise	These can arise for models and DQM. The presence of inherent uncertainty is relevant for model identification.

3.5 Periodic Model Identification Process

In addition to the standard self-declaration of potential models by Model Users, Model Owners and Process Owners, MRPG should perform a semi-annual model identification process. This is a sample-based approach, leveraging the processes captured in M7, to identify processes which may potentially utilise models (within the scope of the RTF) which are not captured within the model inventory. MRPG will engage the respective Process Owners, who are to provide either a declaration of any models used within their processes, or an attestation that no models are used within their processes.

3.6 Expansion of Model Universe Scope

The Model Universe Scope to which the model definition is applied (for both models and DQM) is encapsulated in the Model RTF. Any proposed expansion to the universe to include a new model family must adopt the following process:

- Determine the list of potential new models (meeting the model definition requirements) in the new model family.
- Assessment of resourcing impact.
- Engagement with Global Head, Model Risk Management to discuss the proposal.
- Table of proposal to the MRC including future “go live” date.
- If MRC approves the expansion, MRM will engage with the Business to –
    - Determine MRM requirements, including authoring of an appropriate model family standard, development and validation templates and scheduling of the development and validation work

- Setting timelines for when the Policy and Group Standards will apply to the new model family[6]
- Updating the RTF as part of next cycle to include new model family.

4. OWNERSHIP

4.1 Model Owner Assignment

The Model Sponsor is responsible for assigning the Model Ownership role [GMRP 2.2b]. The Model Ownership role is central to the effective functioning of the MRM framework and is typically the accountable executive responsible for the model development to support a particular business area or function.

Model Owners must be assigned to both in-house models and third-party models [GMRP 2.3c].

The Model Owner may appoint additional roles such as model developer (for development activities) or model manager (for administrative activities) to manage the MLC, without diluting their accountability as the 1LOD.

Given the central nature of the Model Ownership role, to ensure effectiveness of the role, the number of in-use models allocated to a given Model Owner must be no more than 50, of which no-more than 25 must be material (materiality rating 3 or 4). In addition, for in-use material models the Model Owner must be at least a Band 4 individual. Model Ownership must be specified in the applicable Model Family Standards. Any proposed deviations to the conditions (e.g., due to the nature of the models being considered) must be documented and approved in the applicable Model Family Standards.

4.2 Process Owner Responsibilities

Certain tasks in the MLC may reside outside of the Model Owner direct responsibility and instead will lie with applicable Process Owners as accountable executives. Examples could include where the:

- model monitoring process is performed by a function independent of the Model Owner, or
- model overlay process is performed by a function independent of the Model Owner, or
- model implementation process is performed by a function independent of the Model Owner.

In such instances the Model Owner should work with the applicable Process Owners on any model related matters. Where the ownership of tasks normally assigned to the Model Owner lies with Process Owners outside of the Model Owner responsibility, this must be specified in the applicable Model Family Standards.

[6] Failure to meet those agreed timelines would require a dispensation to be raised for continued model usage to avoid a breach of policy, or an Issue to be raised in M7 for instances where a dispensation is not granted leading to a Policy breach.

5. INVENTORY

5.1 Introduction

The Global Analytics Model Explorer ("GAME") is the central repository for model information within the Group[7].

All models used within the SCB Group, and which are in-scope of the GMRP, must be recorded in GAME [GMRP 2.4a].

5.2 Establishing Inventory Records

Process Owners and Model Users are responsible for the identification and confirmation to the Model Owner, of any potential model candidates encountered, in scope of the GMRP, that are used within their Business, Product or Function units.

The Model Owner is responsible for ensuring that all tools identified as models, that are in-scope of the GMRP, are recorded in GAME. This includes all models that have been identified, are under development, live in systems and have been decommissioned.

The recording of model details in GAME[8] is an ongoing process; as the model goes through the MLC, more details become available and will need to be updated accordingly.

For a complete list of fields and roles accountable for maintenance please refer to confluence page – ***Data Dictionary: Group Model Inventory (GMI) Download***.

Any queries relating to inventory management and information required should be referred to MRPG at GroupModelRiskPolicy@sc.com for guidance.

5.3 Upload Requirements

The following approved documents must be uploaded to GAME for each new model and for each major change version:

New Models or Major Model Changes[9]

Items	Details	Accountable for Upload
Terms of Reference	Completed & Signed-Off	Model Owner
Tollgate Meeting Document(s)	Completed	Model Validator
Technical Development Document (TDD)	Completed & Quality Assured	Model Owner
Technical Validation Report (TVR)	Completed & Quality Assured	Model Validator
Model Approval Request	Completed & Signed Off	Individual DMA or Model Owner for committee signoff
User Acceptance Testing Report	Completed & Signed-Off	Model Owner
Post Model Adjustment Report	Completed & Signed-Off	PMA Process Owner
Model Issue Report (for issues raised outside of TVR)	Completed	Individual raising the issue (GMV or Model Owner)
For Third Party Validation Work	Endorsement of 3rd party selection	Relevant Head of GMV (TR or BB)
	Executive Summary Report	Model Validator
External Approvals and Notifications	Submissions and Final Approvals	Defined in applicable MFS

[7] This is also referred to as the Group Model Inventory

[8] Additional fields are expected to be added to GAME throughout 2025, contact MRPG for the list of currently supported fields.

[9] These tables should be applied as applicable. E.g., some items such as 3rd party work or decommission plan or minor model changes may not be applicable.

The following documents must be uploaded to GAME for each minor change version:

Minor Model Changes[9]

Items	Details	Accountable
TDD reflecting minor change	Completed & Signed-Off	Model Owner
Notification to GMV	Evidence	Model Owner
GMV confirmation (MRR RR2/RR3/RR4)	Evidence	Model Validator

After go-live, the following documents must be uploaded to GAME under the Model ID record as they become available in the Model Life Cycle:

Model Life Cycle[9]

Items	Details	Accountable
User Verification Testing Report	Completed & Signed-Off	Model Owner
Model Monitoring Report	Completed	Monitoring Process Owner
Revalidation TDD	Completed & Quality Assured	Model Owner
Revalidation TVR	Completed & Quality Assured	Model Validator
Annual Status Assessment	Completed	MRPG
Decommission Plan	Completed & Signed-Off	Head of MRPG
Re-activation Report	Completed & Signed-Off	Head of MRPG

Sensitive Data Consideration

Care must be taken to avoid the inclusion of sensitive data in any reports that are uploaded to GAME in accordance with internal data privacy requirements and applicable regulation, e.g., UK General Data Protection Regulation (UK GDPR) and UK Data Protection Act 2018 (DPA 2018). The document owner is responsible for ensuring that no sensitive data is contained in their documentation or in supporting evidence, and that suitable masking or anonymization is applied.

5.4 Maintenance of Inventory Records

Accountability

Model Owners are accountable for the accuracy, completeness and timeliness of their inventory records [GMRP 2.4b]. Model Owners must therefore ensure that their records are maintained as close to real time as feasible. Where certain tasks in the MLC reside outside of the Model Owner direct responsibility the applicable Process Owner is accountable for the accuracy and completeness of those inventory records.

GMV are accountable for the accuracy, completeness and timeliness of inventory records that relate to validation work performed [GMRP 2.4c].

The accountable individual may agree to other parties updating the fields for which they are accountable e.g., via a model manager. However, the ultimate accountability for the accuracy and completeness still resides with the accountable individuals.

Model Owner Attestation

Model Owners must evidence the accuracy, completeness, and timeliness of their inventory records through confirmation (highlighting gaps with proposed remediation plans where required) provided to MRPG on a semi-annual basis in accordance with timelines specified by MRPG. In practice this work is facilitated by delegation to model managers or Model Developers, to confirm the accuracy and completeness and then feedback to the Model Owner on identified gaps and proposed fixes.

For fields owned by a Process Owner who is distinct from the Model Owner, the Process Owner must provide a suitable attestation to the Model Owner to facilitate the Model Owner overall attestation on the inventory record.

This process must be completed within one month after the reporting point.

5.5 Review of Model Inventory

On a semi-annual basis, MRPG must review the veracity of the model inventory records [GMRP 2.4d]. All Data Quality ("DQ") Gaps identified are to be communicated to Model Owners, who must rectify the gaps in accordance with the priority-based timeliness stipulated by MRPG. All gaps will be monitored and reported to the respective model risk committees. Model Owners are accountable for ensuring all DQ gaps are reflected within the Model Owner Attestations.

5.6 Model Sponsor Attestation

The Model Sponsor Attestation is a critical control to demonstrate Model Sponsors understand and have met their responsibilities under the Model Risk Framework, Policy and Standards. Model Owners are responsible for ensuring this governance process is completed and reported to MRPG in accordance with timeframes defined by MRPG, and ensure each Model Sponsor attests to the following for all models under their sponsorship:

- Understanding of their first-line roles and responsibilities under the Model Risk Framework, Policy and Standards
- Completeness and accuracy of the list of models under their sponsorship
- Appointment of Model Owners for each model
- Suitability of each model for their intended use case(s)
- Awareness of all model weaknesses[10], limitations and risks associated with model use, with action plans and timelines for remediation recorded in Model Risk System or M7 as appropriate.
- Compliance of each model with relevant regulatory requirements
- Completeness, accuracy and timeliness of key fields[11] captured in the Group Model Inventory
- Re-affirm[12] the Risk Acceptance of model issues under their purview including any associated conditions. This includes the effectiveness of any ongoing monitoring requirements and that all required compensating controls are still in place.

The attestation must be provided at least annually [GMRP 2.4e].

[10] This includes continued application of model overlays and poor model performance as indicated by performance threshold breaches.

[11] Reliance can be placed upon the Model Owner semi-annual inventory confirmation process, however all data quality issued are to be acknowledged and confirmation the Model Sponsor will be accountable to ensure timely remediation

[12] If the model sponsor no longer believes Risk Acceptance is a suitable course of action, the model issue should be reverted to open status with suitable action plans and timelines presented to the DMA for approval.

6. MODEL INITIATION

6.1 Introduction

Overview

Model initiation is used to formally kick-off the delivery of a new model or major change to an existing model. Model Initiation is not required where there is no change to a model, for example as part of the standard revalidation process for an existing approved model with no proposed changes.

The purpose of this stage is to:

- Understand and document the business case, usage requirements and modelling objectives,
- Identify or reconfirm the individuals who will fulfil the development roles,
- Ensure that role holders collectively plan and agree the model development delivery, and
- Plan for the incorporation of any required tollgate meetings.

The Model Owner (or delegate) is responsible for ensuring that the Terms of Reference ("ToR") is documented, capturing the information above, on the standard ToR template [GMRP 2.6a] maintained by MRPG.

6.2 Model Initiation

Model Initiation is comprised of the following steps:

6.2.1 Usage Requirements and Modelling Objective

Model Initiation begins with a clear understanding of usage requirements for the development of a new model or for changes to be made to an existing model. This includes the rationale for why it is important to initiate the work at the current time rather than at a future date (e.g., business opportunity or regulatory requirement). At this stage consideration must be given as to the existence of approved models which already fulfil the usage requirements. The Model Owner is responsible for ensuring there is engagement with the Model Sponsor (or delegate) and Model Users to solicit feedback in relation to the desired modelling objectives. Where there are multiple use cases being considered, this too needs to be considered.

The agreed usage requirements and modelling objective must be documented in the standard ToR template. The information captured will vary depending on whether the delivery relates to a new model or major change to an existing model. The focus of the latter being the nature and impact of the change, rather than a new set of usage requirements and modelling objectives as would be relevant to the former. In accordance with requirements in Section 16, the Model Owner, taking into consideration input from Model Developer [GMRP 2.5 a,b], must estimate the Model Risk Rating (MRR), on a best effort basis using an expected materiality rating and expected uncertainty rating. The expected ratings must be documented in the ToR.

Where there is a proposal to adopt a third-party model, consideration must be given to the requirements detailed in Section 6.3 ("Third Party Model Requirements"), and the benefits and risks associated with third-party adoption versus internal model development must be documented in the ToR.

6.2.2 Model Development Planning

For internally developed models the Model Owner is responsible for identifying or reconfirming the Model Developers who will fulfil the development roles. Where a third-party model is adopted the Model Sponsor is responsible for identification of an appropriate Model Owner who is responsible for ensuring compliance with the GMRP and relevant Standards.

The Model Owner, or delegate, is responsible for entering a development plan in GAME system, including the start and end date of the development cycle, as well as any proposed tollgate meeting dates. Where there are changes to the development plan, the Model Owner, or delegate, is required to notify GMV and MRPG in advance on at least a quarterly basis.

Development and Validation plans relating to models used for capital calculations will also be presented at the MRC for approval. The MRC may request approval of Development and Validation plans for other model types as deemed necessary, on a case-by-case basis.

6.2.3 Tollgate meeting

Tollgate meetings provide a forum for Model Owners and Model Developers to meet with members of GMV, and other stakeholders where relevant (e.g., Model Users, Process Owners, and other relevant parties), to present modelling progress at key stages of the development process and solicit independent feedback on potential concerns.

Tollgate meetings are optional but provide an opportunity for Model Developers to solicit independent feedback for any potential red flags before a final model submission for validation. The Model Owner is responsible for ensuring details relating to proposed tollgate meetings are documented in the ToR. This includes proposed dates of occurrence of tollgate meetings and the intended scope of coverage of the meetings. For example, the scope of coverage could be aligned with key aspects of the development cycle; theory covering model design and formulation (inputs, process, outputs); test results and required overlays; monitoring and control aspects.

Where models are developed as part of a committed regulatory delivery, it is recommended to incorporate tollgate meetings to allow for the early identification of any major concerns. If the Model Owner is of the opinion that tollgate meetings are not required in this instance, they must ensure a documented rationale for this decision is provided in the ToR.

To ensure independence of the validation process, the expectation is that the frequency of tollgate meetings is low and is aligned with key stages of the development process. Tollgate meetings must not be used as a continuous feedback mechanism to solicit GMV feedback, as this could breach independence. For example, where the development cycle takes 3 months, monthly tollgate meetings would be acceptable, whereas daily or weekly tollgate meetings would not be acceptable.

6.2.4 ToR Signoff

Where model initiation relates to the development of internal models, the ToR document must be signed off by the Model Sponsor (or delegate) and the Model Owner [GMRP 2.6b] and notified to GMV, to allow for planning of validation activities.

Where model initiation relates to the adoption of a new third-party model or system rather than internally developed models, additional ToR signoff is required from GMV.

The completed and signed ToR must be uploaded to GAME by the Model Owner (or delegate) and the model recorded in GAME as “in-flight”.

On receiving the ToR notification, GMV is responsible for entering the validation plan in GAME and periodically aligning it with any updates made to the model development plan.

6.3 Third-Party Model Requirements

A third-party model is a model made available to the Group by a vendor or some other provider outside of the SCB Group. The model may be an “off-the-shelf” product, or it may have been modified for the Group.

The use of third parties has the potential to introduce incremental model risk to the Group. For example:

- Model risk transparency, for example accuracy of the model code or production implementation, representativeness of test data, and the breadth, depth and rigour of analysis and testing carried out by the third-party.
- The Group’s ability to conduct effective review and challenge of third-party models.
- Managing contractual disagreements.
- Contingency planning, if the third-party is unable to continue to provide the agreed goods and services.

A robust process for selection of a third party model must include a clear definition of requirements and address the following points; vendor scope and responsibilities; formal reporting structure; ongoing review schedules; dispute and escalation procedures; system for tracking outstanding issues; audit coverage; quality assurance requirements; service level agreements (SLA) regarding qualified staff and their availability; and appropriate turnaround timeframes to ensure complete ongoing and continuous coverage.

SLA’s must include the ability of third-party to meet the requirements stated in the GMRP, Group Standards and any applicable Model Family Standards. Due to lack of transparency often associated with third-party model solutions, the following points must be taking into consideration when documenting terms of the SLA:

- requirements to ensure a level of model documentation and testing to reasonably comply with SCB GMRP, Group Standards and applicable MFS
- requirements to ensure that the level of information disclosed in support of the model is sufficient to enable SCB validation activities to be performed
- requirements for any ongoing support in relation to the model (for example, if there are model issues raised by GMV and/or model performance issues identified, the mechanism and timeframe to remediate such matters)
- requirements to disclose information as may be required to support any part of the MLC
- any specific requirements in relation to artificial intelligence or machine learning risks as detailed in Section 18 of the Group Standards (for example, explainability and bias).

The Model Sponsor is accountable for ensuring a robust process is followed for third-party model selection. The Model Sponsor must also appoint an internal Model Owner who will be responsible for ensuring compliance with the GMRP, relevant Standards and any relevant regulatory requirements (for example PRA SS2/21[13]).

GMV must be consulted in the early stages of the vendor procurement process to provide challenge on whether a third-party solution is warranted or if existing approved models can meet the proposed usage requirement.

Where the third-party is unable to comply with all or some of the requirements listed above, the appointed Model Owner is responsible for escalating this to the Head of GMV for consideration and approval for validation work to proceed. If subsequent validation work is then conducted, any gaps

[13] SS2/21 PRA Supervisory Statement: Outsourcing and third-party risk management. March 2021.

relating to the above requirements should be highlighted in the validation report to ensure transparency on the level of review and challenge that was able to be performed.

7. MODEL DEVELOPMENT

7.1 Introduction

Overview

Model development includes the research, analysis, development, testing and risk assessment that goes into proposing a new model or model change to meet business requirements set out during the initiation phase. Model development must be performed by individuals with appropriate expertise and experience.

Model development begins, following the completion and approval of the Terms of Reference by the Model Owner and Model Sponsor, or delegate (c.f. Section 6.2.4).

The Group Standards define a set of minimum requirements in relation to model development requirements, adopting a principles-based approach. The depth and rigour of these requirements are to be linked to the perceived level of model risk, via internal model risk ratings. The implementation of the requirements for a given model type are articulated in the applicable Model Family Standards which must be approved by Global Head, Model Risk Management.

The Model Owner is accountable for ensuring that the model development activities, as performed by the Model Developer, meets the requirements set out in GMRP, Group Standards and the applicable Model Family Standards.

The Model Owner, or delegate, is responsible for entering the development plan into GAME in a timely manner to allow for tracking of the model delivery.

Model Risk Ratings

The level of perceived model risk for any given model is captured via the Model Risk Rating ("MRR"), ranging from RR1 (lowest) to RR4 (highest). The intensity and frequency of development activities is linked to the MRR and must be documented as part of the Model Family Standards requirements for model development for a given model type.

Each Model Family Standards should contain a clear rationale for in-scope and out-of-scope activities applicable to a given MRR. For example, the level of testing required for a model with lower MRR may be lighter than for a model with higher MRR and the frequency of model performance monitoring might be longer for models with lower MRR than for higher MRR. If no differentiation is applied, the highest standard will be assumed to apply across all models.

On occasion the application of heightened standards will be driven by the model type, purpose or use case. For example, models with material impact on financial accounting disclosure will always be subject to heightened standards regardless of MRR. Similarly, where there are regulatory requirements related to development activities for a given model type, for example, requirements for models used in the calculation of Pillar 1 or 2 capital, this defines a minimum requirement regardless of the MRR. Where this is the case, it must be clearly specified in the applicable Model Family Standards.

At the end of the Model Initiation phase, the Model Owner is required to estimate the MRR, on a best effort basis taking into consideration the input of the Model Developer, by assessing materiality in line with the applicable Model Family Standards and uncertainty in line with criteria

in the Group Standards. The MRR must be re-assessed at the end of the development process based on any additional information that has come to light.

Tollgate Meetings

Tollgate meetings provide a forum for Model Owners and Model Developers to meet with members of GMV and other stakeholders, to present modelling progress at key stages of the development process and solicit independent feedback on potential concerns. Meetings are optional, at the discretion of the Model Owner, and are scheduled as part of the ToR.

Where models are developed as part of a committed regulatory delivery, it is recommended to incorporate tollgate meetings to allow for the early identification of any major concerns. If the Model Owner is of the opinion that tollgate meetings are not required in this instance, they must ensure a documented rationale for this decision is provided in the ToR.

Since the development process is “live” (i.e., model development is still in progress) when the meetings occur, it is important that any feedback provided remains independent of the development process and does not suggest or confirm specific modelling choices.

For example, it is acceptable for GMV to provide feedback suggesting that further support would be expected as part of a final model submission for a given modelling choice, or that certain modelling choices could lead to conceptual soundness issues. It is not acceptable to provide feedback detailing what should be provided, suggesting alternative modelling choices, or suggesting solutions to observed issues, as this would breach independence requirements.

To ensure independence of the validation process, the expectation is that the frequency of tollgate meetings is low and is aligned with key stages of the development process. Tollgate meetings must not be used as a continuous feedback mechanism to solicit GMV feedback, as this could breach independence. For example, where the development cycle takes three months, monthly tollgate meetings would be acceptable, whereas daily or weekly tollgate meetings would not be acceptable. The recommendation is that GMV attend meetings mainly in the role of an observer and provide written feedback on the TT as a follow up to the meeting.

To further ensure that the tollgate process preserves independence, the Model Owner is responsible for ensuring that each tollgate meeting is documented on the standard Tollgate Template (“TT”) with input from the Model Developer and the Model Validator. As the last part of the tollgate process, the Model Validator is responsible for uploading the final completed tollgate template to GAME.

7.2 Model Development

Model Owners are the accountable executive for the development process, responsible for ensuring that all the below considerations are taken into consideration by Model Developers as part of the model development process.

7.2.1 Model Development Design

An effective development process begins with a clear statement of purpose to ensure that the model development is aligned with the intended use. As part of the selection process the existence of previously approved models that address the same target problem must be considered. Assuming there is no viable candidate, a new model will need to be developed. The design, theory, and logic of the model must be conceptually sound and mathematically and statistically correct.

As part of the model design process Model Owners and Model Developers must consult with Model Users to solicit feedback which can be used to challenge the methods, the underlying assumptions, and the outputs of models, and help ensure that the model appropriately reflects

economic and business realities. Model User feedback captured as part of the use testing requirements, is expected to feed into ongoing model development considerations.

The rationale for the given model selection must be articulated, comparing against alternative solutions considered as part of the model development process. This must be documented and, where possible, supported by published research and/or industry practice.

The Model Owner is responsible for ensuring that the model solution is conceptually sound and is designed to meet the business requirements [GMRP 2.7a]

7.2.2 *Model Input Data*

MFS Requirements - Data Quality Management Procedures ('DQMP')

The Model Owner (or delegate) is responsible for ensuring that the applicable Model Family Standard specifies[14] data quality management procedures, applicable to models in scope, including:

- rules to specify requirements for data quality, accuracy, availability (including the data sources used), and relevance to ensure that data used within models is suitable.
- requirements for documentation and justification of proxies, transformations, and/or the use of expert judgement.
- risk controls and criteria to be applied to help mitigate higher levels of data uncertainty (e.g., where alternative data sources or unstructured data is used, or to ensure data privacy requirements are adhered to).
- any heightened requirements for handling of data for use in data intensive models (e.g., higher level of controls to be applied to ensure the suitability of data for use)
- roles and responsibilities for the management of the quality of data used for model development.

Model Input Data Requirements

Data used to develop a model is of critical importance, and Model Developers are responsible for documenting the use of data in the model, including the sources of the data.

Model Developers must ensure that the data used within a model is both suitable and consistent with the theory behind the chosen model.

The Model Developer is responsible for ensuring data quality, accuracy, availability, and relevance, meet requirements specified in the applicable DQMP. This should be supported with appropriate documentation and, where possible, testing (e.g., data quality accuracy and relevance tests) to support conclusions.

The Model Developer is responsible for ensuring there is a full description of both observable and non-observable data, including the source of such data. Examples of observable data include time-series of market data observable over a required modelling time horizon, or prices from liquid tradeable instruments. Examples of unobservable data include inputs that are determined by expert judgment, or prices from illiquid instruments.

The Model Developer must justify the representativeness of the data for the underlying portfolios, products, assets, or customer base the model is intended to be used for. Where this is not the

[14] Reference to an external standalone DQMP is also permissible (e.g., in the form of a department operating instructions).

case Model Developers should assess the impact on the MRR and highlight an appropriate model limitation.

The use of any data proxies, transformations (adjustments) to modify the data, or use of expert judgement to specify the data, must be documented by the Model Developer. This must include the rationale for their use together with any related assumptions.

Model Developers are responsible for ensuring there is no inappropriate bias in the data used to develop a model and that any relevant internal and external data requirements have been complied with (e.g., data privacy regulations).

Where there are heightened risks in the data structures, e.g., the use of interconnected data sources and the use of any alternative or unstructured data[15], this must be documented by the Model Developer.

The Model Owner (or delegate) is responsible for ensuring all relevant data related items are entered in GAME[8] (e.g., description of data, source of data, use of adjustments or proxies, data related assumptions, use of unstructured data or interconnected data).

Higher levels of data uncertainty arising from any of the considerations in this section must be reflected in the model uncertainty (model input data) rating for the model.

7.2.3 Model Methodology

The model methodology, including the mathematical specification, numerical techniques, and approximations, must be fully described highlighting key modelling assumptions, and known modelling limitations. Where there are judgmental or qualitative aspects included in the model methodology, these must be appropriately justified and documented accordingly.

In-model adjustments

Where model adjustments are used to address model limitations as part of the model design (referred to as “in-model adjustments”), these must be documented, including the rationale linking the adjustment to the associated model limitation, and how those adjustments will be calculated over time. Such in-model adjustments are considered to be part of the model rather than a model overlay, however where the limitation can be addressed by additional development work, the Model Developer is responsible for establishing clear remediation plans.

The Model Owner (or delegate) is responsible for ensuring that all such in-model adjustments are recorded in GAME[8], including how the methodology will be applied over time and the rationale for application.

The uncertainty rating (model specification) must reflect the heightened risks that arise when there are multiple ways to formulate a model (i.e., using different modelling assumptions that could lead to different results), as well as any associated limitations and the application of in-model adjustments to reduce the risks.

7.2.4 Model Outputs

A full description of model outputs must be provided, including diagnostic output. Where there are post-processing transformations applied to the model output as part of the model design, this must be documented.

[15] Unstructured data means they do not have a pre-defined data model or pre-existing structure (e.g., social media feeds).

An understanding of model output uncertainty and potential inaccuracy, arising from model limitations, are an important part of the model development process and must be documented accordingly. Where possible this must be quantified, for example, by using confidence intervals around statistical model's point estimate or assessing the impact of non-observable or missing factors within a model. Where quantitative assessment is not possible, a qualitative assessment of model uncertainty and inaccuracy must be provided.

The Model Developer is responsible for highlighting key sources of model risk and any modelling limitations. The Model Owner is responsible for ensuring compensating controls are proposed to address known modelling deficiencies and reduce the impact of model output uncertainty arising from self-identified model limitations.

7.2.5 Model Overlays

Model overlays are considered as being applied post the final model output. This is different to in-model adjustments that are applied as part of the design / methodology of the modelling construct and considered part of the model.

Where there is a significant level of model uncertainty it can be prudent to apply model overlays (post-model adjustments or management adjustments) to ensure conservatism in the model output. If applied, this must be justified and substantiated with a clear definition and where possible, a measurement of this conservativeness, together with conditions under which this applies.

Where an overlay is applied to address known modelling limitations this should be clearly documented, in accordance with requirements in Section 12, and where the limitation can be addressed by additional development work, the Model Developer is responsible for establishing clear remediation plans. While model overlays may provide a mitigant for uncertainty in final model outputs, they must not be used as a substitute to proper model development to address modelling issues.

7.2.6 *Model Development Testing*

A key component of the model development process is Model Developer testing, which must consider both component and aggregate model testing to assess the overall functioning of a given model. Testing must be documented in a clear and concise manner. For each test it is expect that there is a clear description of; (i) the purpose of the test, (ii) design of the test including success criteria, (iii) execution of the test and (iv) summary results with commentary and evaluation. The expectation is that more detailed analysis will be performed for informative samples. Based on the aggregate outcome of the tests performed the Model Developer must document the expected operating boundaries of the Model under which model performance is expected to be acceptable. The expected operating boundary must be entered into GAME[8].

Model Developer testing must be aligned with the target use case(s) of the model and Model Users should be consulted in relation to testing results obtained. The exact nature of testing will depend on the type of model being considered and the perceived level of model risk. Where possible and meaningful, tests addressing the following must be considered as part of Model Developer testing for all proposed use cases:

i. Model Accuracy

Testing must assess the model accuracy, using quantitative metrics where possible. Where there are regions of deterioration these must be identified. Where numerical or statistical routines are adopted, testing detailing convergence and error analysis must be included.

ii. *Model Robustness and Stability*

Tests to assess the robustness and stability of a model must be performed. This could include, for example life cycle testing to ensure that a model performs as expected over key events, or statistical testing to assess stability of various model components based on a given data set.

iii. *Known Limitations*

The expectation is that testing will focus on areas of known limitations or weaknesses and, where possible, quantify the impact for each use case. Where a quantitative assessment is not possible, qualitative arguments should be provided to ensure that the impact of model limitations is made transparent.

iv. *Stress Testing & Sensitivity Analysis (forward-looking)*

Testing should include stress testing of model inputs to highlight potential model limitations under extreme parameter and/or market data, and to assess boundaries of model performance. Models used as part of regulatory required stress testing must include tests that are consistent with regulatory requirements.

Sensitivity analysis should be performed to assess model responsiveness to changes in parameters and/or market data and ensure consistency of model output to make sure they fall within an expected range. Varying several inputs simultaneously can provide evidence of non-linear interactions.

v. *Implementation*

Tests must be performed to verify the implementation of the model specification within the testing or development environment is consistent with the model specification in the technical development document. This is in addition to implementation testing requirements in Section 10 which addresses the translation of a model from a development environment to a production environment and consists of unit testing, user acceptance testing and user verification testing.

vi. *Benchmarking*

Where possible, testing should include a comparison of the proposed model against alternative benchmark (or challenger) modelling assumptions. This could include a comparison against models developed as part of the model selection process. The extent to which comparisons against benchmark models have been conducted should be considered in the Model Uncertainty Rating (via Model Specification).

vii. *Outcomes Analysis (backward-looking)*

Tests to demonstrate that the model output is consistent with corresponding actual outcomes, either historical or other relevant market data, should be performed. The precise nature of this comparison will depend on the model in question. For example, this could include the accuracy of a forecast or estimate or an evaluation of the rank-ordering ability of a model. The choice of quantitative or qualitative technique will generally depend on the model methodology, availability of data and perceived model risk. One example of a quantitative method is back-testing of actual outcomes versus model forecasts.

viii. *Limiting Cases*

Where possible, testing should be performed to confirm limiting case behaviour with known model outputs.

ix. Regulatory Required Testing

Where there are regulatory testing requirements that are applicable to a model this must be included explicitly as part of the development testing.

In general, different tests have different strengths and weaknesses under different conditions. Any single test is rarely sufficient and therefore Model Developers must apply a variety of tests to ensure the soundness of a model.

The tests listed above are generic in nature and apply across all model family types. The expectation is that these will be assessed for relevance and inclusion into the applicable Model Family Standards and, as applicable, embedded in the technical development document template. The intensity of testing should reflect the perceived level of model risk as captured by the MRR. Where possible, additional tests to the core tests listed above, should be supplemented as relevant to a specific model type.

7.2.7 *Model Use Control Framework*

Details of the coding-library and production environment within which the model is to be embedded must be provided.

Models must be supported by a suitable model use control framework to ensure that the model is used as intended and that it resides in a controlled environment where no unauthorized changes to the model can be made. This includes data quality controls to prevent manual overrides (e.g., to the model inputs, the coding algorithm, or the model outputs), and system access controls to ensure that only qualified individuals can access the model.

Where models reside in a controlled library environment under the purview of the Model Owner, the Model Owner or delegate is responsible for ensuring that no unauthorized changes can be made to the model code, including data consumed by the model and output produced by the model.

In cases where the model is either re-implemented in a production system directly or the production system consumes models from a controlled library environment, the system owner is responsible for ensuring that appropriate data and system access controls are in place, to prevent any unauthorized access (e.g., to source data, model code or library used or to model outputs). The Model Owner (or delegate) must discuss with the system owner to understand the control framework so that it can be included as part of the technical development document or as part of the applicable Model Family Standards.

7.2.8 *Network Risk*

The model portfolio is the complete set of individual models used across the Group. Model risk can be transmitted across the model portfolio through interconnections and interdependencies between models.

A model network is a set of models that are operated together. An individual model may belong to more than one model network. Increased aggregate model risk due to network effects is referred to as “network risk”. A network may be:

- Vertical network: one model output is another model’s input. This can result in increased model risk due to propagation from the feeder model to the consuming model.

- Horizontal network[16]: two or more models are operated together. This can result in increased model risk if the models are not aligned, for example if the models are based on inconsistent inputs or assumptions.

As part of the development process, the Model Developer must identify any cases of network risk to allow the Model Owner to assess and propose suitable mitigation. To aid transparency the Model Developer must identify any upstream (feeder) models used by the model under development, as well as any models to be operated in parallel. A table must be provided listing the model IDs of such models and whether they correspond to vertical or horizontal risks.

The risk assessment must also consider if any in-model adjustments or overlays have been applied as part of the larger network (e.g., to upstream feeder models, or other component models) and the potential impact on the current modelled output.

The Model Owner is responsible for ensuring that vertical and horizontal network risks are entered into GAME[8] as part of the model inventory record.

Network risk should be considered as a generic factor when assessing the model materiality and model uncertainty ratings to ensure that vertical and horizontal model connections have been taken into consideration.

7.2.9 *Model Monitoring*

The Model Owner is responsible for assessing the model risks identified by the Model Developer and mitigating them, where feasible, through design choices and compensating controls. Where meaningful sources of residual model risk are identified during the model approval, monitoring must be used to keep check on changes in that residual risk over time.

The proposed monitoring approach, frequency and thresholds must be detailed in the development document or cross referenced to the Model Family Standards if the monitoring approach is applied at model family level. This includes the rationale for choice of tests or criteria selected, the Process Owner responsible for the monitoring process, and actions required on the occurrence of a breach against specified thresholds. The expectation is that continual breaches against specified thresholds will at minimum lead to a discussion around the breaches with remediation actions.

The Process Owner for the model monitoring process is typically the Model Owner, but this may not always be the case and must be specified in the applicable Model Family Standard. Where not specified, the Process Owner will be assigned to the Model Owner. Monitoring arrangements should be proportionate to the perceived level of model risk as captured by the MRR for the model in the first instance. Where more accurate quantitative measurements are directly available for the residual risk, this may be used to drive the appropriate monitoring arrangement.

7.2.10 Regulatory Self-Assessment

Where there are regulatory requirements applicable to a given model, for example, as applicable to models used to compute Pillar 1 or 2 capital, the Model Owner is accountable for ensuring there is an internal assessment performed against the relevant regulations. The minimum expectation is that a clear table is provided containing the list of relevant regulations with evidence supporting compliance, for example, by pointing to the relevant part of the development documentation or explicitly explaining compliance.

[16] Where a model is comprised of a number of sub-components, each performing self-contained calculations these component models may be regarded as part of the horizontal network within the aggregate model.

7.2.11 *Development Documentation*

The Model Owner is responsible for ensuring the model is documented by the Model Developer in accordance with requirements in the Group Standards and applicable Model Family Standards.

Model documentation is critical in ensuring that the Model Sponsor, Model Owner and Model Users, have the ongoing ability to understand, maintain and change the models as appropriate. Good model documentation is necessary to avoid the risk of having this knowledge reside only with a small number of personnel. Model development documentation should be sufficiently detailed so that an independent third party with the relevant expertise would be able to understand how the model operates, to identify the key model assumptions and limitations, and to replicate any parameter estimation and model results.

Model documentation requirements are standardized in the form of a Technical Development Document ("TDD") per model family type (or sub-type).

Each TDD must be sufficiently detailed and complete to enable third party replication of the model. At a minimum it must consider all aspects listed in Sections 7.2.1 – 7.2.10 and 7.2.12 – 7.2.14, together with an Executive Summary providing an overview and a Model Owner Recommendation concluding on the suitability of the model in relation to the intended purpose.

In addition, for models with an artificial intelligence or machine learning processing component, the additional risks listed in Section 18 must also be considered.

Careful consideration must be given to the data used within a model, particularly in relation to sensitive data and applicable regulation e.g., UK GDPR and DPA 2018. The Model Owner must ensure that no sensitive data is contained in the TDD, and that suitable masking or anonymization is applied.

Model Risk Rating (MRR)

The Model Owner Recommendation, taking into consideration input from the Model Developer, must specify the proposed Materiality Rating [0,1, 2, 3, 4] and proposed Uncertainty Rating [A, B, C, D], with justification based on the criteria from the applicable Model Family Standards and Section 16.2 and Section 16.3 of the Group Standards, and translated into the final MRR [RR1, RR2, RR3] based on the MRR matrix in Section 16.1.

The level of testing and support provided in the TDD for a given model is expected to increase with the MRR of a model (i.e., more required for riskier models). GMV will assess the level of developer documentation provided as part of the model submission taking into consideration the MRR.

Documentation Templates

Given the idiosyncratic nature of models across different family types, each Model Family may define bespoke TDD templates (with appropriate versioning) for models within that family ensuring that GMRP and Group Standards requirements have been met. All new development work must use the latest version of the TDD. Where bespoke templates are not adopted, the Standard TDD template should be used.

In addition to the templates used to capture individual model development activities it is recognized that there may be a need to introduce additional template types for certain model families to capture development activities performed in relation to specific use-case considerations. For example, a template to capture portfolio model performance for Counterparty Credit Risk or Value at Risk models, to allow for an annual overarching review in accordance with regulatory

expectations. Where additional template types are required, these must be detailed in the applicable Model Family Standards.

To ensure consistency the latest version of the template for each TDD must reside in a secure location, maintained by MRPG, where no unauthorized changes can be made. Each new version of a TDD template, and subsequent changes to a TDD template must be approved by Global Head, Model Risk Management, or delegate with notification to Global Head, Model Risk Management.

Staged Submission

Where it is possible to complete self-contained sections of the TDD, the Model Developer may decide to hand the completed sections to GMV rather than necessarily waiting for the full TDD to be completed. For example, breaking the model submission down into suitably aligned sections of the TDD covering; design and model formulation (design, inputs, process, outputs), testing, overlays, other risks (usage framework, network risk), monitoring and regulatory compliance. Each section is still expected to go through a peer-review process as detailed in Section 7.2.12.

To ensure independence, any sections of the TDD handed to GMV will be regarded as final and not subject to change, apart from the possible addition of more detail. Similarly modelling aspects covered by those sections will be considered as locked down (i.e., that part of the model is considered as submitted to model validation) and not subject to further change, apart from possible minor bug fixes (with no material impact on the output impacting conclusions in the TDD) or documentation issues, resulting from issues identified in the validation process. Any change to the model specification or subsequent implementation will be deemed a model change and will be required to go through the model change process (c.f. Section 13).

7.2.12 *Quality Assurance*

As part of the first-line accountability it is important to have a quality control process in place. The Model Owner is responsible for ensuring that there is a peer review process in place for the TDD to ensure completeness and compliance in relation to requirements detailed in the Group Standards (c.f. Sections 7.2.1 – 7.2.11 and Section 18), applicable Model Family Standards and any embedded requirements explicitly laid out in the TDD template. The peer reviewer must be independent of the Model Developer authoring the report, and both must be recorded in the TDD.

The Model Owner (or delegate) must sign off on the final completed TDD. Where a delegate is specified, this must be of suitable seniority, the level of which must be detailed in the applicable Model Family Standards. In addition, the quality assurance process should confirm that fields in GAME, for which the Model Owner is the accountable executive, are up to date prior to submission of the TDD to GMV.

7.2.13 *Additional Requirements for Third-Party Models*

The Model Sponsor is responsible for ensuring that all third-party models have an assigned internal Model Owner to ensure compliance with the GMRP and relevant Standards.

The use of third-party models poses challenges for model risk management related activities because the modelling expertise is external and model components may be considered proprietary. To the extent possible, the expectation is that third-party models are subject to the same principles as applied to in-house models, as captured via Sections 7.2.1-7.2.12 above and Section 18. The level of detail in the documentation should be sufficient to allow for independent validation work to be performed.

Documentation and testing are particularly important for third-party models, given the proprietary nature and lack of transparency often encountered. As such there is an onus on Model Owners to ensure that vendors provide the necessary level of documentation, testing and ongoing performance monitoring to support the ongoing usage of such models. This includes the ability to meet internal model risk management requirements, ability to enable completion of the relevant internal TDD, and ability to verify the relevance of any vendor supplied data and related assumptions for the intended use case(s). SLAs with vendors must include the requirements listed in Section 6.3. Failure to provide a sufficient level of detail may mean that the scope of validation that can be performed is limited in nature, resulting in the potential for higher model risk.

8. MODEL VALIDATION

8.1 Introduction

Overview

Independent Model Validation is the set of processes and activities intended to verify that models are performing as expected, in line with their design objective and business uses. Model Validation must be performed by individuals with appropriate knowledge, expertise, and experience, who are independent of first line development and user activities [GMRP 2.9b]. Within SCB this role is played by a Model Validator who is a member of GMV which is part of MRM.

All model components, including input data, processing unit and outputs are subject to independent validation. The standard applied to validation activities is that of “effective challenge” to ensure that models are conceptually sound, to understand modelling assumptions and identify potential limitations, and to assess their possible impact. In addition, GMV must check adherence to the GMRP, Group Standards, applicable Model Family Standards, as well as any applicable regulatory requirements.

The Group Standards define a set of minimum requirements in relation to model validation, adopting a principles-based approach. The depth and rigour of these requirements are to be linked to the perceived level of model risk, via internal MRR. The implementation of the requirements for a given model type are articulated in the applicable Model Family Standards which must be approved by Global Head, Model Risk Management.

Model Risk Ratings

Whilst the Group Standards set out the breadth of activities to be performed by GMV, the depth and rigour of validation activities should be commensurate with the level of perceived model risk, as captured by the MRR ranging from RR1 (lowest) to RR4 (highest).

Due to the complex nature of modelling and differences across models in the various family types, each Model Family Standards must define requirements for validation of models within their scope, allowing for differentiation of intensity based on the level of the MRR at the time of validation – with more expected for riskier models.

For example, the level of independent testing could vary across MRR with RR4 requiring the highest level (e.g., full replication), RR3 a lower requirement (e.g., partial replication), RR2 lower again (e.g., some independent testing) and RR1 the lowest (e.g., no independent testing). Certain activities would be mandatory across all MRR, e.g., assessment of developer documentation and testing, compliance with regulatory requirements.

On occasion the application of heightened standards will be driven by the model type, purpose and use case. For example, models with material impact on financial accounting disclosure will always be subject to heightened standards regardless of MRR. Similarly, where there are

regulatory requirements related to validation activities for a given model type, for example, requirements for models used in the calculation of Pillar 1 or 2 capital, this defines a minimum requirement regardless of the MRR. Where this is the case, it must be clearly specified in the applicable Model Family Standards.

Handover Protocol

For new models and major model changes, a handover protocol should be established to ensure there is appropriate delivery of model documentation and testing, relevant codes, and appropriate access to systems for the Model Validator to run independent testing and verify the developer test results prior to the commencement of validation activities.

8.2 Model Risk Rating Assessment

Model Validation begins with an assessment by the Model Validator of the MRR as proposed by the Model Owner which is part of the TDD. This should include a review of the accuracy and relevance of the information used to assign the components of the MRR, including the source of such data.

The MRR is comprised of two components, the Materiality Rating (MR) with values [0, 1, 2, 3, 4], and the Uncertainty Rating (UR) with values [A, B, C, D]. These combine to generate the MRR with possible values [RR1, RR2, RR3, RR4].

The MR is largely based on objective criteria and must be assessed against the definitions provided in the applicable Model Family Standards, with consideration for the Group level guidelines provided in Section 16.2.

The UR is more subjective and must be assessed against the Group Standards definitions in Section 16.3, as well as the applicable Model Family Standards interpretations of these requirements.

The final MRR must also be checked for accuracy to ensure that the combined MR and UR produces the correct value as determined by the table in Section 16.1.

Where there is a disagreement on the MR, or the UR, or the final MRR (e.g., due to the need to override the MRR), the Model Validator and Model Owner (or delegate) must discuss to see whether an agreement can be reached.

- Where an agreement is reached, the relevant changes must be made to the TDD by the Model Owner (or delegate)
- In the event no agreement is reached, the matter must be escalated to the relevant Head of GMV (Traded Risk or Banking Book) for a final decision. The Model Owner (or delegate) must then update the TDD with any relevant changes

The Model Validator is the accountable individual for ensuring the final MRR, MR and UR (including components) are correctly captured in GAME.

Once the final MRR is determined, the Model Validator must check that the level of detail in the TDD is appropriate for the MRR rating. Where this is not the case the Model Owner is responsible for ensuring the TDD is enhanced with the required detail before any model validation work will commence.

The assessment of the Model Risk Rating must be documented by the Model Validator in the applicable TVR, as determined by the MRR.

8.3 Model Validation

Independent Model Validation review and challenge is required for all new models and major model changes. Model Validation must also be repeated periodically as part of an ongoing revalidation requirement at a frequency commensurate with the MRR, the requirements of which are covered in Section 8.4.

The focus of this section is Model Validation requirements for new models and major model changes. Where a validation is conducted in connection with a major change, the focus of the validation approach will be around the change, but the TVR will continue to form a complete document (for example, the previous validation report will be updated to incorporate the change with appropriate versioning).

Model Validators are responsible for ensuring that all the below elements are taken into consideration as part of the model validation process.

8.3.1 Assessment of Model Development Submission

This section focuses on the assessment of the materials provided in the TDD for new models and major model changes and mirrors the model development requirements as detailed in Section 7.2 of the Group Standards. For new model submissions and major model changes the expectation is that the latest developer documentation template (TDD template), appropriate to the model risk rating, is utilized.

Gating Mechanism

Before commencing the formal validation work, the Model Validator must determine if the materials provided in the TDD are on the appropriate template and are of a sufficient standard to enable a validation to commence. Where there are significant gaps in the submission such that, in the view of the Model Validator, meaningful validation work cannot commence, or where the wrong template is utilised, the Model Validator must reject the TDD submission, and the validation will be halted. The Model Owner is then responsible for ensuring the gaps are remediated by the Model Developer before the TDD is re-submitted and validation can commence.

Where the gaps relate to provision of more detailed support for the model, that do not impact the model design (i.e., the model is not changing) or the implementation (i.e., no further redevelopment work would be required), or the assessment of model performance (i.e., conclusions drawn will not change), these details may be provided during the validation. Any documentation gaps remaining at the end of the validation process, will be addressed via raising documentation issues with an appropriate severity level of either material weakness, identified concern or immaterial issue. Where there is disagreement in relation to the required level of detail in the TDD submission or associated severity levels of the remaining documentation issues, this should be escalated to the Global Head of GMV for a final decision.

The gating process should complete within 2 weeks of the scheduled validation start date or receipt of the TDD submission, whichever is the later date.

Model Development Design

The Model Validator must review and challenge the model development design and selection in relation to the business problem that it is intended to solve, and to ensure it is aligned with the defined use-cases. Consideration must be given as to whether there already exists an approved model which addresses the business problem.

The validation process must assess the design theory and logic of the model to ensure that it is conceptually sound and mathematically and statistically correct. The Model Validator must check to see where Model User feedback has been incorporated in the development process.

The Model Validator must assess the rationale for the final modelling choice and any supporting evidence provided and, where possible, determine if it is aligned with industry practice.

Where issues on development design are highlighted, these would be generally be recorded as model specification issues under the standard taxonomy as detailed in Section 17.2.

Model Input Data

The Model Validator must review and challenge the model input and development data, and whether it has been sufficiently supported in the TDD to ensure it is both suitable and consistent with the theory for the chosen model. This should include a review of how the data meets requirements specified in the DQMP of the applicable Model Family Standards.

Consideration must be given to whether inputs are observable (e.g., liquid market data) or non-observable (e.g., illiquid assets, un-observable model parameters) which may require expert judgment to determine and increase the level of modelling uncertainty.

The level of support provided for data quality must be assessed by the Model Validator to ensure accuracy and completeness. The level of support provided for data integrity must be assessed to ensure that it is, and will continue to be, available for model consumption and is relevant to the model use case. This includes the representativeness of data for the use case in question (e.g., for underlying portfolios, products, assets, or customer base). The Model Validator should assess any additional data uncertainty arising from interconnected data and/or the use of unstructured data. Where insufficient support is provided, or deficiencies are observed, the Model Validator should assess the resulting modelling limitations and ensure this is reflected in the proposed MRR.

The Model Validator should review and challenge the data bias assessment in the TDD and ensure that any relevant internal or external data requirements have been considered by the Model Developers (e.g., data privacy regulations).

Where data proxies are used the Model Validator must assess whether they have been sufficiently justified and are reasonable for the model use case. Any use of pre-processing of data via transformations (adjustments) must be assessed to understand why it is required and if it has been specified accurately, including the assumptions behind such adjustments. Any use of expert judgement to data must be assessed to understand why it is required and if it has been appropriately justified.

Where additional limitations, not captured in the TDD, have been identified as part of the validation of model input data, where possible, the Model Validator must try to provide an assessment of the potential impact on the model output. This could be quantitative or qualitative in nature.

Where issues on model input data are highlighted, these would be generally be recorded as model input data issues under the standard taxonomy.

Model Methodology

The Model Validator must review and challenge the model methodology, including the conceptual soundness, mathematical specification, numerical techniques, any approximations used, and the level of support provided for such modelling choices. Where a model is comprised of components, the assessment must, where possible, consider the components in isolation and in aggregate.

Modelling assumptions must be assessed for reasonableness as applicable to the proposed modelling solution, for example, whether these are in line with industry standards or supported by published research. The Model Validator must assess the modelling limitations identified in the TDD and determine whether there are any additional limitations not already captured.

Where additional limitations, not captured in the TDD, have been identified as part of the validation of the model methodology, where possible, the Model Validator must try to provide an assessment of the potential impact on the model output. This could be quantitative or qualitative in nature.

Where expert judgment is used in the processing unit, this must be assessed to determine whether the necessary level of support has been provided, and if it will potentially lead to increased model risk.

Where in-model adjustments are used to address model limitations as part of the model design, the Model Validator must review if the documentation of the approach is sufficient, including how these adjustments will be maintained over time and if the root cause limitation could be addressed via further development work. This includes whether the materiality of the in-model adjustments or a trend of use of recurring model adjustments for the same model limitations are indicative of flawed model design or misspecification in the model construct warranting remedial actions.

Where issues on model methodology are highlighted, these would be generally be recorded as model specification issues under the standard taxonomy.

Model Outputs

Model output described in the TDD must be assessed for clarity, completeness, and accuracy. Any use of a post-processing transformation must be assessed to understand why it is being applied and if it has been specified accurately.

The Model Validator must assess whether the impact of model limitations on the model output, in terms of accuracy and uncertainty, is sufficiently transparent and accurately represented. Where possible, the Model Validator must assess the effectiveness of any proposed compensating controls on reducing the model output uncertainties.

Where issues on model outputs are highlighted, and not already covered by model input data, or model specification, these would be generally be recorded as model output issues under the standard taxonomy.

Model Overlays

The use of any model overlays applied must be reviewed and challenged in terms of rationale for application, the conceptual soundness of the proposed approach, and the level of support provided. This includes assessment of the conservative nature of the overlay (e.g., definition of conservative, the measure used and any conditions under which this applies).

Consideration must be given as to whether additional model development could be reasonably warranted to remove the need for any model overlays. This includes whether the materiality of the model overlay or a trend of use of recurring model overlays for the same model limitations are indicative of flawed model design or misspecification in the model construct warranting remedial actions (e.g., recalibration or redevelopment).

Where issues on model overlays are highlighted, these would be generally be recorded as model output issues under the standard taxonomy.

Model Development Testing

The Model Validator must assess the model development testing performed as documented in the TDD, considering both component and aggregate model testing to determine if it provides a sufficient level of support for the overall functioning of the given model for each use case considered.

The documentation of the testing must be assessed to ensure that for each test there is a clear description of; (i) the purpose of the test, (ii) design of the test including success criteria, (iii) execution of the test and (iv) summary results with commentary and evaluation. The Model Validator must assess the items individually to ensure they are appropriate and meaningful; for example, is the purpose of the test meaningful, is the success criteria appropriate, has the test been executed correctly and are the test results and conclusion consistent. The Model Validator should review and challenge the expected operating boundaries proposed by the Model Developer, as derived from the outcome of the testing results.

The tests performed must be assessed for relevance in relation to the target use-case(s). The Model Validator should check the involvement of the Model Users in relation to the tests performed.

The expectation is that testing will focus on known areas of model weakness and on understanding model limitations, as relate to the proposed use case(s). The exact nature of testing performed will depend on the type of model being considered and the perceived model risks (with intensity determined by the MRR rating). The Model Validator must give consideration as to whether the following types of tests are relevant and practical for the model under review:

- Model Accuracy (mandatory)
- Model Robustness and Stability (mandatory)
- Identified limitations (where identified this should be a focal point of testing)
- Stress testing and Sensitivity analysis (where relevant, mandatory for models used in regulatory stress testing)
- Model Implementation (mandatory to demonstrate the specification is implemented)
- Benchmarking (where possible)
- Outcomes Analysis (where possible and relevant)
- Limiting Cases (where possible)
- Regulatory Required Testing (where relevant this is mandatory)

The Model Validator must assess the level of testing performed in aggregate to determine whether the variety of tests employed are sufficient to support the soundness of the modelling choice and implementation and highlight any areas of perceived weakness. As part of the assessment, the Model Validator must take into consideration the MRR for the model – with testing intensity expected to be aligned with the level of the MRR.

Where the development testing is pointing to areas of weakness in the model, where possible, the Model Validator must attempt to assess how those weaknesses will present themselves in terms of the final model output and whether this is consistent with the TDD conclusion.

Issues raised in relation to the development testing potentially encompass numerous dimensions and the nearest appropriate single descriptor for the issue should be selected from the model issue taxonomy (e.g., model specification, implementation and operating environment, model documentation, model performance etc.)

Model Use Control Framework

The Model Validator must assess the suitability of the model use control framework. This includes data quality controls to prevent manual overrides (e.g., to the model inputs, the coding algorithm, or the model outputs), and system access controls to ensure that only qualified individuals can access the model.

Where issues on the model use control framework are highlighted, these would be generally be recorded as implementation and operating environment issues under the standard taxonomy.

Network Risk

Where models are operated together, either as part of a vertical network (e.g., one model feeding another model) or as a horizontal network (e.g., two or model models operated together with inconsistent assumptions) there is a potential for increased model risk due to interconnectedness.

The Model Validator must assess the network risks described in the TDD, including the table of vertical and horizontal risks, and determine if the proposed mitigation is reasonable. This should include the impact of any in-model adjustments or overlays applied to models in the larger network in terms of impact on the current model. Where additional network risks are identified the Model Validator must assess if these dependencies could lead to increased model risk requiring additional compensating controls. The Model Validator must verify that the networks risks are correctly registered in GAME by the Model Owner and amend with any additional identified network risks.

Where issues on the network risk are highlighted, these would generally be recorded as implementation and operating environment issues under the standard taxonomy.

Model Monitoring

Model monitoring is used to control residual model risks accepted during the model approval stage. The Model Validator must review and challenge the proposed monitoring approach, including the criteria to be monitored, the frequency of proposed monitoring, the suitability and effectiveness of proposed thresholds, and proposed actions in the event of a breach.

The assessment must allow for monitoring arrangements that are proportionate to the perceived level of model risk as captured by the MRR for the model in the first instance. Where more accurate quantitative measurements are directly available for the residual risk, this may be used to drive the appropriate monitoring arrangement.

Issues raised in relation to the model monitoring potentially encompass numerous dimensions and the nearest appropriate single descriptor for the issue should be selected from the model issue taxonomy (e.g., model specification, model input data or model performance).

Regulatory Compliance

Where there are regulatory requirements applicable to a given model, the Model Validator must assess the TDD internal assessment against relevant regulations. The expectation is that the TDD provides a clear table with a complete list of relevant regulations with evidence supporting compliance, for example, by pointing to the relevant part of the TDD or explicitly explaining compliance.

The Model Validator must assess both completeness of the identified regulations and the evidence used to determine compliance.

Where issues on the regulatory compliance are highlighted, these would be generally be recorded as regulatory compliance issues under the standard taxonomy.

Development Documentation

The Model Validator must assess the TDD in terms of completeness, accuracy, and quality of documentation versus the expectations in the applicable TDD template. The expectation is that each TDD is sufficiently detailed and complete to enable third party replication of the model.

The Model Validator must check that the development work is captured on the appropriate TDD template and that it is compliant with the GMRP, Group Standards and applicable Model Family Standards.

The Model Validator must confirm that the TDD has undergone the necessary peer review process and that the Model Owner (or designee) have signed off the final version.

Additional Requirements for Assessing Third-Party Model Development

If the model is from a third party, the Model Validator must check that there is an assigned internal Model Owner to ensure compliance with the GMRP and relevant Standards.

The Model Validator must assess the model development documentation based on the internal standards above, however taking into consideration the nuances of third-party models e.g., proprietary nature of vendor models, limited transparency, etc. The Model Validator should assess the suitability of any vendor supplied data for the intended use case(s) and proposed performance monitoring to support the ongoing usage of such models.

If there is insufficient detail or clarity which would prevent the full scope of validation work from being performed, the Model Validator must challenge the development documentation. Where this is the case, the Model Validator must highlight the associated gaps in the validation report to ensure transparency of the level of review and challenge that was able to be performed. This includes specifying any exclusions from the validation report due to a lack of available information (e.g., where there is missing testing, or limited ongoing monitoring specified).

The final validation outcome must take into consideration any limited scope of review performed, with the potential for heighted model risk due to any associated gaps in review, as well as assessing the materiality of those gaps and what compensating controls exist (e.g., ongoing monitoring of model performance while further test data is collated).

8.3.2 Independent Validation Testing

In addition to assessing the modelling aspects in Section 8.3.1 the Model Validator should also conduct additional independent analysis and testing as is deemed necessary. Independent testing takes many forms, for example, this could include alternative benchmark modelling which relaxes or modifies some of the underlying modelling assumptions, the use of different numerical or statistical routines, or a complete replication of the model itself to ensure the implementation is correct. Where there are perceived areas of modelling weakness independent testing should be targeted on those modelling assumptions and limitations to better understand the impact. In general, the testing types detailed in Section 8.3.1 would all be relevant as candidates for independent testing.

The depth and rigour of independent testing performed must be aligned with the MRR, and requirements specified in the applicable Model Family Standards. Where there are any regulatory

requirements relating to independent testing requirements (e.g., if full replication is mandatory), this will override the MRR requirements.

As with Model Developer testing each test must contain a clear description of; (i) the purpose of the test, (ii) design of the test including success criteria, (iii) execution of the test and (iv) summary results with commentary and evaluation.

Independent testing must be clearly identified as such so as not to avoid confusion with the developer testing. For example, a separate table detailing which tests are part of the TDD and which are from the Model Validator would help to clarify on this point.

8.3.3 Model Issues

In accordance with Section 17, the Model Validator may identify issues with a model during the validation process.

Issues are usually raised in relation to a segment of the model which could relate to the entire model or a subset of the model e.g., a particular use case, a portfolio or product, a currency etc. In this way we are potentially able to isolate the issue impact and apply compensating controls or restrictions in relation to certain segments.

The Model Validator must assign each issue an appropriate severity; Material Weakness, or Identified Concern, or Immaterial [GMRP 2.9g]. Each issue must also be assigned to an appropriate risk category from the standard taxonomy defined in Section 17.2 and document the issues in the TVR. The Issue Priority Level, with associated maximum remediation timelines, is determined by a combination of the model materiality and issue severity (c.f., Section 17).

As part of the validation process the Model Validator must discuss the issues with the issue owner (typically the Model Owner). Where material weaknesses are observed, these must be communicated to all stakeholders (Model Sponsor, Model Owner, Control Functions) as soon as is practically possible to allow for remediation planning. All other issues must be communicated to the issue owner in a timely manner.

Where an issue relates purely to model documentation and where the gaps relate to provision of more detailed support for the model, that do not impact the model design, or the implementation, or the assessment of model performance, these details may be provided during the validation. Any documentation gaps remaining at the end of the validation process will be addressed via raising documentation issues in the TVR with an appropriate severity level of either material weakness, identified concern or immaterial issue.

The final TVR must contain a list of all issues that remain open at the end of the validation process, at which point the validation is marked as completed. Following validation completion, the list of issues will be communicated to the issue owner(s) who is responsible for providing credible action plans with target dates for completion to address each issue within 10 business days[17]. Where the issue is a material weakness the issue owner is responsible for specifying compensating controls to mitigate the risk until the issue is remediated. Once the action plans have been received the Model Validator is responsible for ensuring the open issues and associated action plans are entered into GAME before the approval meeting. The issue owner is responsible for tracking progress against the action plan, with oversight provided by MRPG. The Model Sponsor (as the 1LOD owner of model risk) is ultimately accountable for issue remediation, and ensuring compensating controls are effective where required.

[17] Failure to meet the 10-day period should be escalated to the relevant DMA, with continued failure escalated to the MRC.

Where a model issue pertaining to Model A is discovered during a validation of Model B, the issue must be recorded in connection with Model A (both in GAME and, in the TVR for Model A or on the standalone model issue template uploaded to the Model A inventory record) rather than Model B. Where the issue results in a change (worsening) of the validation outcome, the updated version of the TVR must be presented to the Delegated Model Approver ("DMA") for reapproval.

Where an issue is raised, and it is agreed by GMV and the Model Owner that the materiality of the issue is *de minimis* (i.e., very small in impact), it is acceptable to put controls in place to ensure that the issue remains de minimis in the future. In such instances the issue owner may propose an action plan to monitor the materiality of the issue on an ongoing basis to ensure the materiality remains within a tight pre-defined threshold. If the materiality of the issue grows and there is a breach in the threshold, model remediation is required. The threshold, monitoring frequency, criteria to be monitored and actions required in the event of a breach will all need to be specified as part of the action plan. Once the monitoring has been implemented, the issue may be submitted for closure in the usual manner.

For further details on the issue management process, refer to Section 17.

8.3.4 Model Validation Outcome

The final Model Validation Outcome decision must be based on the aggregate impact from segments of the model with identified model issues and on the severity of those issues.

The basic principle is that Validation Outcome is largely driven by the Material Weaknesses observed in the model with Identified Concerns considered as a secondary driver for this decision process.

In the table below we list guidance criteria for determining the Validation Outcome.

	Issue Severity		
Validation Outcome	**Material Weakness**	**Identified Concern**	**Immaterial**
Acceptable	Zero	Aggregate impact of identified concerns is not severe enough to suggest the model is unacceptable for use ***and*** credible action plans are in place	N/A (as long as there is high level of certainty that the issues will remain immaterial)
Conditionally Acceptable	One or more with credible action plans in place ***and*** the aggregate impact of the segments is not severe enough to suggest the model is unacceptable for use.		
Unacceptable[18]	One or more without credible action plans in place ***or*** the impact across all identified segments on aggregate is severe enough to suggest that the model is unacceptable for use.	Aggregate impact of identified concerns is severe enough to suggest the model is unacceptable for use ***or*** credible action plans are not in place.	N/A (as long as there is high level of certainty that the issues will remain immaterial)

Provision of Rationale

The Model Validator is responsible for providing a rationale for the Validation Outcome including an explanation of how the severity of the aggregate issues raised maps to the Validation Outcome.

[18] Unacceptable models may still be approved for use, with the application of compensating controls where relevant.

For example:

- For a model with material weaknesses, how the aggregate impact of those issues map to a Conditionally Acceptable or Unacceptable outcome decision.
- For a model that only has identified concerns how the aggregate impact of those issues maps to an Acceptable, Conditionally Acceptable or Unacceptable outcome decision, taking into consideration the likelihood of any of the issues becoming a material weakness.

Ultimately there is a degree of subjectivity involved when assigning issue severity and the table above should be interpreted as providing guidance to the Model Validator which should be re-enforced with a documented rationale in the validation report for the final Validation Outcome. The rationale should also be challenged as part of the quality assurance process by the peer reviewer when reviewing the final validation report.

8.3.5 Validation Documentation Requirements

Validation documentation is critical for demonstrating effective challenge and must clearly describe the decision process followed by the Model Validator, together with supporting evidence, to reach the final validation outcome. Validation documentation requirements are standardized in the form of a Technical Validation Report ("TVR") per model family type (or sub-type).

The TVR must clearly align with the corresponding TDD, to allow for an assessment of all sections, as well as allowing for additional requirements of the validation process, for example, the assessment of the MRR, independent testing (as applicable), issues raised and the validation outcome. At a minimum it must consider all aspects listed in Sections 8.2 and 8.3.1 – 8.3.4, together with an Executive Summary providing an overview of the validation process conducted and the Validation Outcome in relation to the intended use-case. In addition, for models with an artificial intelligence or machine learning processing component, the additional risks listed in Section 18 must also be considered.

Careful consideration must be given to the data used within a model, particularly in relation to sensitive data and applicable regulation e.g., UK GDPR and DPA 2018. The Model Validator is responsible for ensuring that no sensitive data is contained in the TVR, and that suitable masking or anonymization is applied.

Documentation Templates

Given the idiosyncratic nature of models across different family types, each Model Family may define bespoke TVR templates (with appropriate versioning) for models within that family ensuring that GMRP and Group Standards requirements have been met. All new validation work must use the latest version of the TVR. Where bespoke templates are not adopted, the Standard TVR template should be used.

The intensity of review and challenge in the TVR for a given model is expected to increase with the MRR of a model (i.e., more required for riskier models).

In addition to the main templates used to capture individual model validation activities, it is recognized that there may be a need to introduce additional template types for certain model families to capture validation activities performed in relation to specific use-case considerations. For example, a template to capture the review of portfolio model performance for Counterparty Credit Risk or Value at Risk models, performed as part of an annual overarching review in

accordance with regulatory expectations. Where additional template types are required, these must be detailed in the applicable Model Family Standards.

To ensure consistency the latest version of the template, each TVR must reside in a secure location, maintained by MRPG, alongside the applicable TDD where no unauthorized changes can be made. Each new version of a TVR template, and subsequent changes to a TVR template must be approved by Global Head, Model Risk Management, or delegate with a notification to Global Head, Model Risk Management.

8.3.6 Additional Requirements for Third Party Validation Work

While most validation work is performed by GMV, there may be reasons, (e.g., surge capacity requirements), to allow for validation work to be performed by a third-party. Individuals performing validation work must be suitably qualified and independent of the Model Owner, Model Developer, and Model Sponsor (i.e., the 1LOD in the Model Life Cycle).

Where a third-party performs the independent model validation of a model for SCB, the relevant Head of GMV (Traded Risk or Banking Book) must authorise the appointment of the third party. GMV must assign an internal Model Validator for each third-party model, who is responsible for reviewing the third-party independent model validation [GMRP 2.3d].

8.3.7 Quality Assurance

As part of the second-line accountability it is important to have a quality control process in place. The relevant Head of GMV (Traded Risk or Banking Book) are responsible for ensuring that there is a peer review process in place for the TVR to ensure completeness and compliance in relation to requirements detailed in the Group Standards, applicable Model Family Standards and any embedded requirements explicitly laid out in the TVR template. The peer reviewer must be independent of the Model Validator author, and both must be recorded in the TVR.

The relevant Head of GMV (or designee) must sign off on the final completed TVR. Where a designee is specified, this must be of suitable seniority, the level of which must be detailed in the applicable Model Family Standards. In addition, the quality assurance process should confirm that Model Validator related fields for the model are up to date in GAME following the TVR sign off.

8.4 Model Revalidation

Validation activities should continue after a model goes into use, to ensure ongoing use case suitability, track known model limitations and to identify new ones. It is good practice to ensure that models are revalidated based on some fixed interval, including updated documentation and all activities.

Model Revalidation is performed for in use models at a frequency based on the MRR, with a trigger of every 2 years, 3 years, 5 years, and 6 years for models rated RR4, RR3, RR2, and RR1 respectively [GMRP 2.9f]. Models with zero usage and due for revalidation are, by definition, already at the 6-year trigger point and will not be considered for revalidation. The approval of zero usage models will lapse (i.e., be marked as unapproved) and any future usage of the model is contingent on having a revalidation and/or a reapproval in place.

It is permissible to override the revalidation frequency with a higher frequency where there are heightened expectations relating to Model Revalidation. For example, where the models are a material contributor to annual financial accounting disclosures or where there are regulatory

requirements for more frequent validation [GMRP 2.9f]. Where this applies to models within a given model family this must be detailed in the applicable Model Family Standards.

Where poor model performance results are observed as part of model monitoring this could trigger earlier revalidation requirements, as could issues uncovered as part of the Annual Status Assessment process where the MRR and model issues are re-visited.

In exceptional circumstances, e.g., when a model is planned to be decommissioned within six months, the DMA may propose for revalidation to be suspended for a defined duration with approval from the Global Head Model Risk Management.

8.4.1 Revalidation Process

Planning

A revalidation schedule should be established as part of the annual planning process at the start of each calendar year to specify which models will be revalidated in that year based on the MRR as of the planning date, and any regulatory requirements. It is permissible to use more conservative estimates of the MRR for planning purposes.

Where a model shows an increase in MRR during the year, leading to additional revalidation requirements not captured in the plan (e.g., where a model moves from RR3 to RR4, requiring revalidation every 2 years versus the original 3 years), the model will be added to the plan with an aim to complete revalidation in the next 12 months from the point of identification.

Regulatory Revalidation requirements

Regulatory related revalidation will have pre-specified timelines for completion (typically annually) by the regulatory authority as well as scope and rigour of review required.

Internal Revalidation requirements

For all other revalidation work, this must commence within 30 days of the revalidation trigger date as measured from the date of last validation completion. At the time of the revalidation, the model is already housed in a production environment and is being used on an ongoing basis.

Each revalidation must complete within 6 months of the start date, and preferably sooner. Where the developer documentation does not meet the required standards to allow for revalidation to commence, the clock will reset to enable remediation from the Model Owner to address the documentation requirement.

Any revalidation not starting within 30 days of the revalidation trigger date or not completing beyond 6 months is considered in breach of internal revalidation requirements and must be referred to the Global Head of GMV for consideration. This must include the rationale for the delay and the new proposed revalidation timelines. Following approval from the Global Head of GMV, the revalidation dates will be reflected in the revalidation schedule and the model will no longer be considered in breach. For repeat instances, the matter should be referred to the Global Head of MRM for similar consideration with escalation to MRC if deemed necessary.

Developer Documentation

For revalidation work there is no requirement to migrate to the latest TDD template. The Model Owner is accountable for ensuring compliance of the TDD with the GMRP, Group Standards and applicable Model Family Standards.

Revalidation work will be performed based on the existing TDD, which may be using an earlier TDD template rather than the latest TDD template. However, the expectation is still that the existing TDD reflects the latest complete state of the model including all major and minor model changes made since the time of the last revalidation.

Where the TDD contains insufficient information to allow for a revalidation to commence, the TDD content needs to be updated by the Model Developer and the revalidation will be halted until the required level of detail has been added to the TDD. In such instances the revalidation timeline will be reset taking into consideration the required TDD remediation timeframe (i.e., the clock stops until the TDD is resubmitted).

Revalidation

The Model Validator must ensure that the latest version of the TVR template is used to document the revalidation work.

Revalidation must consider the following points:

- Re-assessment of the MRR, including the accuracy and suitability of the information used to determine the MRR.
- Compliance of the model documentation, as captured on the TDD, in relation to GMRP, Group Standards and applicable Model Family Standards. Failed compliance will be raised as a Documentation issue.
- Any changes (both major and minor) to the model since the time of the last validation.
- Any applicable change in regulation.
- Previous validation work performed including issues raised in the last validation of the model.
- Recent model performance reports.
- Continued suitability of any in-model adjustments or model overlays (Post Model Adjustment and/or Management Adjustments) that are currently applied.
- Continued suitability of any imposed model usage restrictions.
- Any relevant findings from the last Annual Status Assessment (ASA).

Model Revalidation follows the same process flow as the original validation, as detailed in Sections 8.2 and 8.3 above. The Model Validator will re-assess the MRR as per the criteria in Section 8.2 to ensure that the level of development documentation and testing (as reflected in the TDD) is still suitable. Where the MRR has increased and the level of detail in the TDD is no longer appropriate, the Model Owner is responsible for ensuring that the Model Developer updates the TDD with the required level of detail before the revalidation commences. The Model Validator is accountable for ensuring any required updates to the MRR are captured in GAME.

The Revalidation exercise will assess compliance of the model documentation, as captured on the TDD, in relation to GMRP, Group Standards and applicable Model Family Standards. Failed compliance will be raised as a documentation issue, with appropriate severity level of either material weakness, identified concern or immaterial issue (c.f. Section 17.2). A material weakness issue on documentation will require re-documenting the model on the latest TDD template and both material weaknesses and identified concerns must be remediated within 6 months. Where there is disagreement in relation to the required level of detail in the TDD or associated severity levels of documentation issues, this should be escalated to the Global Head of GMV for a final decision.

Model Revalidation must consider whether the conclusions reached in the original validation remain valid, for example, due to changes in market condition, or changes in portfolio construction, and whether tests performed are still valid or require updates. This will generally depend on the nature of the test performed. For example, stress testing conclusions may still be valid if the portfolio is largely unchanged, and the original envelope of testing was sufficiently wide. Other tests with a point in time dependency may need to be updated by the Model Owner (or delegate). The Model Validator is responsible for ensuring that the assessment is conducted in accordance with the latest standards. If there has been limited change to the model, market conditions and model usage, and no performance (or other) issues observed it is possible that a similar conclusion to the last validation may be reached.

The TVR must bring together all model changes into a current view of the model and must be assessed to determine if there are additional concerns or issues that need to be raised as a result. The Model Validator must assess whether additional independent testing is warranted to focus on the new model changes and whether any of the previous independent testing is no longer valid and update accordingly. Where there have been new issues identified from other parts of the MLC, consideration must be given as to whether additional independent testing focusing on those components is required.

Issues raised in the last validation must be re-assessed to determine if they are still relevant, and if the severity rating assigned are still appropriate (with potential impact on the Validation Outcome). Where issues have been addressed the TVR must be updated to reflect this with an explanation. Where new issues are identified these must be recorded in the final TVR and entered in GAME by the Model Validator.

The results of model performance reports and ASA should feed into the revalidation exercise and may either support the previous Validation Outcome or give rise to new issues (e.g., continued poor performance might result in additional performance issues being raised requiring further remediation from the Model Owner). The continued application of any in-model adjustments, model overlays or model restrictions should be assessed for suitability and effectiveness.

The review and challenge of the above items will be documented on the TVR in the same manner as for an initial validation following the requirements in Section 8.3, with appropriate version control.

8.4.2 Model Revalidation Outcome & Reapproval

The final Model Revalidation Outcome will either be Acceptable, Conditionally Acceptable or Unacceptable.

The model is required to go through a similar model approval process with DMA as the original model. Since there has been no new model development to trigger the validation, the Model Validator is responsible for completing a (reduced) approval template, termed the Continued Use Approval Template. The focus of the Model Approval is now on the continuing suitability of the model given any new information obtained as part of the revalidation process.

For further details of the model approval process for revalidation work see Section 9.4.

8.5 Other Validation Assessment Work

In addition to formal validation work conducted as part of the MLC, there may be occasions where GMV are requested for their input and viewpoint on certain analytic tools, or single-use tools/analysis as described in Sections 3.2.2 and 3.2.3. For example to provide support in relation to a review and challenge process, where team members in GMV have the appropriate subject matter expertise.

In these instances, GMV will document their view of the tool or qualitative framework in the form of a validation assessment to record GMV view of the reasonableness of the approach. There is no formal validation outcome (acceptable, unacceptable, conditionally acceptable) associated with this assessment. The completed assessment document will be saved in a secure location.

8.6 Effectiveness of Validation Process

The Global Head of GMV is responsible for establishing a validation effectiveness process to assess ongoing effectiveness of the process on a quarterly basis. This should include an assessment of compliance with the model validation operating controls, including timeliness of planned revalidation work. Other data points that will be used to assess the effectiveness of the validation process should include, but are not limited to, findings raised by Group Internal Audit ("GIA"), external audit and/or regulatory bodies.

Any negative outcomes will be escalated to the Global Head Model Risk Management, for discussion with Global Heads of MRPG and GMV, to determine the root-cause and whether there are systemic matters that require addressing. Any required changes will be tabled at the Model Risk Committee for consideration [GMRP 2.9j].

9. MODEL APPROVAL

9.1 Introduction

Overview

Model approval is the process used to review, challenge, and approve models for use, taking into consideration evidence presented by the Model Owner, Model Developer, GMV and other relevant stakeholders. The Model Owner is responsible for taking the model through the approval process [GMRP 2.10a]. The primary purpose of model approval is to confirm that the model is fit-for-purpose and that the model risk presented by the model is acceptable to the Group [GMRP 2.10b].

Model approval may be carried out for a single model or for multiple models simultaneously, for example a model network where the constituent models are under the ownership of a single Model Owner.

The Model Approver role is central to the effective functioning of the MRM framework, and it is therefore a GMRP requirement that the Model Approver must have a good understanding of the Bank's model risk requirements and does not play any other role in the MLC to maintain independence.

Delegated Model Approvers

The GMRP defines the default role of model approver as the Model Risk Committee ("MRC"), however in practice the authority is delegated to Delegated Model Approvers ("DMA"), via sub-committees or a select group of individuals from the second line [GMRP 2.10d]. For example, the sub-committees

CMAC, TMAC and FCCMAC have delegated authority covering certain Credit Risk, Traded Risk and Financial Crime Compliance models.

DMA must have the technical competence to review and challenge the use of models within their approval scope [GMRP 2.10d]. Where the DMA is an individual from the second line, the approval hierarchy and process must be specified in the applicable Model Family Standards, which must also ensure that the individual acting as DMA is independent of the first line [GMRP 2.10e].

The MRC Secretary must reconfirm the list of DMAs delegated by the MRC at least annually. In addition, where the DMA is an individual, they must be confirmed as on the most recent list of DMAs as part of the approval process.

9.2 Model Approval

The Model Approval process commences upon completion of the Development and Validation processes. We divide the process into 3 steps, the pre-approval process, the approval process, and the post-approval process. Section 9.2 focuses on the approval process for new models and major model changes. The approval process for revalidation (where no modelling changes have occurred) is covered in section 9.4.

9.2.1 Pre-approval process

Approval requests for new models and major model change are documented on a standard template, maintained by MRPG, which define the minimum requirements across all model family types – see section 9.5 for template details.

Where required, additional sub-fields may be added to capture information specific to a given model family and relevant to consideration in the approval process, and the gold copy saved down by MRPG.

The Model Owner is responsible for ensuring the model approval request template is completed, based on information provided by the Model Owner, Model Developer and Model Validator, and supported by a sign-off from the Model Sponsor (or delegate).

Approval requests made without Model Sponsor endorsement will be considered on a case-by-case basis [GMRP 2.10c], which will also consider the rationale for no endorsement as part of the approval process.

The Model Owner, with input from the Model Developer, is responsible for ensuring the following fields are completed:

- Business Requirements (purpose and modelling objective)
- Model Details (Design, Input, Process, Output, Key Test results)
- Identified Model Risks & Compensating Controls (Limitations & Uncertainty, Metrics, PMA, Model Use Risk, Network Risk, Regulatory Risk)
- Model Owner Recommendation
- Third Party Risk (from 3rd party developer work)

The Model Validator is responsible for completion of the following fields:

- Independent Validation Findings (Issues/Responses & Validation Outcome)
- Independent Validation Recommendation
- Third Party Risk (from 3rd party validation work)

- DMA approval review (for committee approvals; in the form of a reference to committee minutes)
- Model Approval (for committee approval; detailing approval outcome, model usage restrictions and any escalation requirements)

In addition, the Model Validator must ensure that all issues in the final TVR are entered into GAME prior to the Model Approval meeting.

The Model Sponsor or delegate is responsible for:

- Endorsement of the approval request.

9.2.2 Model Approval Process

The completed model approval request is combined with the TDD and the TVR, into an approval pack, which is provided to the DMA. The aim of model approval is to provide effective review and challenge and reach an approval outcome.

Where multiple use cases are covered by the TDD and TVR, and submitted for approval, each use-case must be considered separately considering the supporting evidence provided. Different approval outcomes are possible for each use case.

Where a model is presented for approval with material weaknesses, the Model Owner is responsible for ensuring that suitable compensating controls are in place to mitigate the issue, while actions plans are in progress.

Approval Outcome

Taking into consideration evidence presented by the Model Owner, Model Developer, Group Model Validation (GMV) and other relevant stakeholders, the DMA will determine the approval outcome (per use case) as either:

- Approved; or
- Not Approved.

An approval may have associated restrictions on model usage applied to it which must be recorded as part of the approval process and entered in GAME by the Model Validator. A model approved for use with material weaknesses must have suitable compensating controls specified to mitigate the risk.

Where the approval outcome is Not Approved this relates to the use-case submitted for consideration. Note if there were other use-cases that have previously been approved, those outcomes remain in place unless otherwise stated.

Committee Approvals

Where the role of the DMA is played by a committee, the submission of the approval pack must follow the individual committee requirements such as, but not limited to; additional summary templates to be completed, timelines for submission and circulation to committee members in advance of the committee meeting. The committee meeting provides the forum for the review and challenge process, to determine the approval outcome.

Where an individual of the committee is the Model Sponsor for a model submitted for approval, they will not have approval authority for the model in question. However, they may still provide input that will be taken into consideration as part of the committee decision, including, but not limited to, a willingness to accept the residual risk inherent in a model approval outcome.

The approval outcome must be recorded as part of the committee minutes by the Secretary to the Committee.

Individual Approvals

Where the role of the DMA is played by selected individuals from the second line, the expectation is that approval is executed via "approval meetings" with participation from the Model Owner, Model Developer, Model Validator and other relevant stakeholders as mandated by the DMA terms of appointment. Details of the approval hierarchy and process (including approval meeting requirements) must be specified in the applicable Model Family Standards.

Approval meetings can be scheduled per model or for a group of models (each with their own approval request form), however where models are grouped into a single approval meeting, care must be taken to ensure that sufficient time is allocated for discussion so as not to impair the approval process.

The Model Owner (or delegate) is responsible for the scheduling of the approval meeting, which provides the forum for the review and challenge process to determine the approval outcome.

The DMA must record the approval outcome in the approval request template, together with a high-level summary of the meeting discussion, a description of the review and challenge carried out, and the basis for the approval outcome decision. Where there are restrictions on model usage imposed by the DMA as part of the approval, these must be clearly documented.

If, during the approval process, the DMA considers that further approval is warranted (e.g., due to DMA restricted authority, regulatory risk, or materiality considerations), this must be documented with a rationale.

9.2.3 Post-approval Process

Following completion of the approval process there is typically follow-up work required, which might involve updates to the final version of the TDD and/or TVR and/or model issues that have been entered into GAME. Additional work may also be required to enforce any restrictions on model usage imposed by the DMA as part of the approval process. Where the additional work involves further model development activities, this must be recorded in GAME by the Model Owner.

The Model Owner (or delegate) is responsible for ensuring that the completed TDD and Approval Request are uploaded to GAME and all Model Owner fields are updated to ensure accuracy and completeness. This includes the approval outcome and the approval date as well as any other model specific items, for example, new model monitoring requirements or adding the model to existing monitoring requirements.

The Model Validator is responsible for uploading the completed TVR to GAME, ensuring that all validation fields are updated to ensure accuracy and completeness, including any restrictions on model usage, and that any required updates to model issues are made in GAME.

All updates must be completed in GAME within 2 weeks of the approval meeting.

Where the model use case requires external approval, for example, for regulatory capital calculations, the Model Owner (or delegate) must prepare external approval requests according to the relevant Model Family Standards.

9.3 Go-Live Approval Requirements

The Model Owner and applicable Process Owners must ensure that a model is approved prior to the point of go-live and thereafter whenever any change is made to the implemented model. Changes to

parameters and calibration may be allowed without approval if the changes meet applicable threshold and limit requirements as defined in the corresponding Model Family Standards.

Where the model use case requires external approval, for example regulatory, statutory, or accounting purposes, the Model Owner must ensure that external approval is sought only after the completion of independent model validation and approval of the model by the DMA. The model use case cannot go-live until the necessary external approvals are received [GMRP 2.10j].

A Process Owner must not use a model or modelled output unless the model or modelled output has been approved for use in that process. The Process Owner may start using a model within their process once it is confirmed as ready for go-live by the Model Owner [GMRP 2.10k].

9.4 Revalidation Approval Process

Where a model is reviewed as part of ongoing revalidation requirements, reapproval of the model is still required by the relevant DMA. In this case a reduced template is used for approval requests, termed the “Continued Use Approval Request Template”, which is maintained by MRPG, and defines the minimum requirements across all model family types.

The template must be completed by the Model Validator and notified to the Model Sponsor (or delegate) to ensure awareness of any new findings from GMV. Model Sponsor endorsement is not required for ongoing revalidation of existing models.

The process followed is the same as the original approval, however the focus is on understanding:

- Any changes in the MRR
- Any changes (both major and minor) to the model since the last approval as captured in the latest TDD
- Any applicable change in regulation resulting in a model change
- Performance of the model since the last approval via Model Monitoring Reports
- Continued suitability of any in-model adjustments or model overlays
- Continued suitability of any imposed model usage restrictions
- Any issue raised in the Annual Status Assessment process
- Remediation of model issues raised since the last approval
- New issues raised since the last approval arising directly from Revalidation, or from Ongoing Monitoring or the Annual Status Assessment process
- Revalidation findings and recommendation

Documentation and recording requirements of the approval outcome, together with any restrictions on model usage, remain the same as for the original approval process, as do the upload and update requirements to GAME.

9.5 Provisional Approval

Under exceptional circumstances (e.g., to facilitate a trading opportunity, or where usage of the model is risk reducing) models may be approved for use prior to completion of validation and/or for purposes which they were not designed for, via Provisional Approval. In such circumstances the Model Approver is authorized to make this decision subject to setting and documenting any applicable restrictions on model usage, taking into consideration GMV opinion on the conceptual soundness of the modelling approach and potential model risks. This must include an assessment of

the need for compensating controls in the interim until validation and subsequent approval can be completed. Requests for provisional approval must be endorsed by the relevant Model Sponsor.

The list of Provisional Approvals will be monitored and reported to the MRC and relevant DMA by MRPG.

9.6 Use of Unapproved Models

Where a model is used without a model approval in place (either full or provisional) this will result in a breach of Policy unless a dispensation is requested and granted.

Where a dispensation is requested, it must follow the GMRP requirements [GMRP 4.1] and specify appropriate compensating controls to reduce any potential model risk as well as the timelines for completion of required remediation work (e.g., development and validation work). The dispensation request may rely on development testing as evidence and any insights gained from the validation work performed to date. All dispensation requests must be endorsed by the Model Sponsor.

Where a dispensation is not granted, usage of a model without a model approval in place is deemed a breach of Policy and preventative measures should be used to ensure there is no breach. Where this is not possible, the Policy breach must be managed via the Group Operational Risk Framework, with a risk of appropriate severity raised in the M7 platform, including a treatment plan to return to policy compliance within an acceptable period [GMRP 4.2]. The treatment plan and remediation timelines are subject to approval by the Global Head, Model Risk Management and will be tracked by MRPG. The Model Owner (or delegate) is responsible for escalating Policy breaches to the Model Sponsor for awareness.

Dispensations and Policy breaches will be reported to the MRC and relevant DMA by MRPG.

9.7 Escalation

The Model Risk Framework defines an approval hierarchy with the MRC as the de facto model approval committee, and delegation of approval authority via identified DMAs, which may be committees (e.g., CMAC, TMAC, FCCMAC) or specified individuals [GMRP 2.10l].

In the first instance, model risk related escalations should be made to the DMA for the associated model with further escalation following the model approval hierarchy, with MRC as the final escalation point.

Governing committee's terms of reference will specify the escalation path to be followed for in scope models.

10. MODEL IMPLEMENTATION

10.1 Introduction

Overview

Model implementation consists of

- Production Implementation and deployment of a model to a production environment, including original deployment and any subsequent version(s) of the model, within a suitable model control framework.
- Process Implementation, to ensure that the required model use processes and controls are implemented to support the use of the model in their impacted process.

10.2 Production Implementation

Models must be deployed to a production environment in accordance with Software Delivery Framework mandatory controls and processes, as required by Group Tech Policy and the IT Standards. Each model must be implemented in a secure production environment, where no unauthorized changes can be made, with appropriate change controls and ongoing support [GMRP 2.11a]. For the purposes of EUCs "production environment" should be interpreted as registered, in-use, and meeting all requirements of the End-User Computing Policy and Standards – which specifies minimum requirements for access and change controls.

Any model family which requires a deviation from Software Delivery Framework mandatory controls and processes, must be approved by respective system owner and be documented in the respective Model Family Standard.

The implemented version of the model, model control framework and monitoring arrangements must be consistent with the approved TDD. The model control framework and testing must provide end-to-end coverage to ensure proper functioning of the model in the production environment.

If issues are discovered during implementation that require a change in the model the TDD must be updated to reflect those changes and must be assessed against the model change criteria in Section 14.2. Where the change would constitute a major model change, the standard process of independent validation with subsequent submission for approval must be followed.

Production implementation must include the generation of information required for subsequent ongoing-monitoring, ongoing independent model validations and model redevelopment from the point of go-live [GMRP 2.11d].

The Model Owner (or delegate) is responsible for ensuring that models are deployed in production environments that have been thoroughly tested for the intended model purposes. The continued suitability of the production environment must be re-confirmed annually as part of the Annual Status Assessment process by the Model Owner (or delegate)[19]. Areas for consideration will be specified in the form of a checklist maintained by MRPG.

The Model Owner and applicable Process Owners are responsible for identifying the relevant subject matter experts (typically Model Users), with necessary expertise to review and assess results from the user testing process.

User Acceptance Testing

User acceptance testing (UAT) occurs as part of the pre-release process of a model to production and is used to ensure that the version of the model implemented in the production test environment reflects the approved version documented in the TDD and is consistent with the model version tested as part of the development process.

Note, it is often the case that when developing a model, tests are performed on "local" versions rather than in a production test environment. Thus, quite often there are two phases of implementation; (i) implementation in a local test environment – as captured by the development implementation tests in the TDD to ensure that the model reflects the specification and, (ii) implementation of the model in the production test environment prior to release – the subject of the implementation testing in this section.

[19] The expectation is that reliance may be placed on Group Tech Policy and IT Standards, as well as existing control processes within the Group (e.g., IT audit work on specific systems).

Each Model Family Standards must describe the UAT process for models within scope, with reference to any applicable internal SCB policies or standards. This must include requirements for documentation of a UAT report, review and challenge from Model Users, and the process to be followed for failed UAT.

The UAT should seek to verify that:

- Model inputs are feeding correctly, are appropriate for the model and meet any internal data requirements.
- Calculations are accurate.
- Outputs produced suitable for their intended use.

The final UAT report must be presented to the Model Owner (or delegate) to review and signoff, and subsequently to the applicable Model Validator to provide further challenge, ensuring that that any discrepancies have been suitably explained in the UAT report, and provide a second line signoff. Following the first line and second line signoff, the Model Owner (or delegate) is then responsible for uploading the final UAT report to GAME.

Go-Live Process

Following approval and successful UAT, the production go-live decision is taken at process level by the Process Owner and must be taken in a controlled manner to ensure that the Bank is operationally ready, and all the necessary approvals are place, for each use case, prior to using the model, including:

- Verify that all required internal approvals are in place, including the ability to control any restrictions on model usage imposed within the approvals.
- Verify that any remaining open validation issues are not pre-conditions for go-live.
- Verify, where external approval is required, that the model has been validated and that it has been approved by the relevant external party.
- Verify that UAT has been signed off by GMV.

User Verification Testing

User verification testing (UVT) refers to an additional layer of testing performed, post-release of a model to a production environment (i.e., after go-live), to ensure that no issues have arisen as part of the promotion of the code from a test environment to a release environment (e.g., unintentional change in data sources which could lead to unforeseen errors).

Once a model is operational in a production environment, as with the original UAT, UVT should seek to verify that:

- Inputs remain appropriate for the model.
- Calculations remain accurate.
- Outputs remain appropriate for their intended use.

The expectation is that more verification is performed for high materiality and high uncertainty models than for lower risk models. Each Model Family Standards must describe the UVT process adopted for models in scope, with reference to any applicable internal SCB policies or standards, taking into consideration the perceived level of model risk for those models. This includes requirements for documentation of a UVT report, review and challenge from Model Users, and the

process to be followed for failed UVT. The UVT must complete within 1 month[20] of the deployment of the model to production or, for those models with zero usage after deployment (e.g., a financial markets valuation model with no trades booked on it), within 1 month of being used.

Where there are existing robust detective controls in place, such as established ongoing model monitoring, this may be used as an alternative to a separate UVT process to verify that no issues have arisen as part of the production release process within 1 month[20]. Where such an alternative is used, this must be clearly specified in the applicable Model Family Standards.

Any unexpected model behaviour must be communicated back to the Model Owner (or delegate) and Model Validator for consideration to determine next steps (e.g., if the model needs to be removed from production, and further model changes introduced). The Model Owner (or delegate) is responsible for uploading the final UVT report to GAME.

10.3 Process Implementation

User Training

The Model Owner and applicable Process Owners are responsible for identifying Model Users across all impacted processes, for each use case, and providing them with appropriate initial and ongoing user training [GMRP 2.11e]. Model User training should be targeted to minimize potential model misuse risk and ensure an understanding of risks relating to model limitations and model uncertainties. The requirement for training can be waived by the Model Owner where the Model Owner considers that there is no need to provide training, for example the provision of training would not mitigate a perceived risk and concludes there is no training that is “appropriate to the Model Users”. Training requirements must be specified as part of the applicable Model Family Standards.

Controls

The Model Owner must work with Process Owners to ensure that a model use control framework is implemented to support the use of the model in their impacted processes, for each use case, consistent with that described in the development documentation which includes any controls to adhere to restrictions on model use imposed during model approval [GMRP 2.11f]. This requirement is relevant for initial model release and release of subsequent versions of the model. The Model Family Standards must specify details of the model use control framework for models within a given model family.

Where a model is upgraded to a new version the Model Owner is accountable for ensuring the model version description, as recorded in GAME, specifies the associated model changes relative to the prior version. Where multiple versions of models are required to be in-use in a production environment concurrently, the model version description, as recorded in GAME, must also capture the rationale for why different versions are required to be in co-existence (e.g., due to different use case coverage). Where such co-existence is only a temporary event the restrictions associated with the approval, should specify such timeframes to help track the replacement of the prior version by the later version.

Model Users are responsible for understanding the approval status of the model version used, including model limitations and any restrictions on model use [GMRP 2.11g]

[20] Since the UVT occurs after go-live, it is important that any issues are identified as quickly as possible.

11. MODEL USAGE – ONGOING MONITORING

11.1 Introduction

Overview

Ongoing monitoring is necessary to confirm that a model is correctly implemented and continues to perform as expected, and to provide transparency of the impact of known model limitations or identified model risks on the model outcome.

As part of the development process the Model Owner is responsible for ensuring that ongoing monitoring requirements are defined for each model, with an aim to assess ongoing model performance and control any identified model risks for each use case. This includes defining meaningful and measurable quantities which can be monitored, at a specified frequency, against appropriate thresholds allowing for determination of success or failure of the quantity being monitored and the associated lead time required for respective monitoring to commence following model go live. This must be documented in the applicable TDD by the Model Developer, or where this is generic to a model family referenced to the applicable Model Family Standards. The Model Owner should ensure awareness of the associated lead time required for respective monitoring to commence following model go-live is transparent and appropriate for the model use-case.

GMV will review the proposed metrics and thresholds to be applied and provide effective challenge as part of the validation work performed on each model.

Ongoing monitoring can take many different forms, for example it could consider aspects of the following as appropriate to the model in question:

- Model Usage – monitoring of materiality of a model at Group or other applicable (e.g., legal entity) level.
- Model mis-use – monitoring operational risk breaches that have occurred as relates to misuse of a model in relation to the approved use-case.
- Performance accuracy – assessing the model estimate or ability to calibrate against pre-specified tolerance levels under both normal and stressed market environments.
- Benchmark comparison – assessing the model estimate against a model built with alternative assumptions.
- Outcome analysis – assessing the model estimate against historical or observed values.
- Limitations or identified risks – assessing the impact of the limitations or identified risks on an ongoing basis to ensure that these remain bounded.

Expectations relating to Performance Monitoring

At a minimum all models are required to have performance testing in place to ensure that models continue to perform. This should include:

- Ensuring that any parameter estimations and model construct remain appropriate and valid.
- Ensuring that assumptions remain applicable for the model's intended use.
- Ability to detect whether changes in products, exposures, activities, clients, or market conditions should be addressed through in-model adjustments, model overlays, recalibration, redevelopment, or by the model being replaced.
- Ability to detect when the model has been used beyond the intended use and whether it continues to deliver acceptable results.

A range of tests should be performed with the exact nature of testing dependent on the type of model being considered. Where possible and meaningful, tests addressing the following should be considered when defining ongoing model performance tests:

- Model accuracy to reaffirm performance within operating boundaries.
- Outcomes analysis to demonstrate that the model output is consistent with corresponding actual outcomes.
- Ongoing benchmarking against alternative models to assess model assumptions.
- Sensitivity analysis to affirm the robustness, consistency, and stability of the model.
- Analysis of overrides to evaluate and analyse the model overlays made (e.g., stability of magnitude and direction of overlays).
- Parallel outcome analysis to assess whether new data should be included in model calibration.

Specification within Model Family Standards

The Model Owner (or delegate) is responsible for ensuring the model monitoring requirements are documented in the applicable Model Family Standards, and for ensuring that all monitoring requirements associated with a model are recorded in GAME within 10 business days from the conclusion of the approval process.

Ongoing monitoring requirements are expected to be aligned with the perceived level of model risk as captured by the MRR which is a function of materiality and uncertainty (c.f. Section 16.1). Models with the highest MRR of RR4 would have more stringent ongoing monitoring requirements than those with the lowest MRR of RR1, with a further level of differentiation allowed for intermediate MRR's of RR3 and RR2.

The expectation is that ongoing monitoring must not have a frequency of more than 1 year (and then only for the lowest rating of RR1). For higher levels of MRR, the expectation is at least quarterly and more frequent where practical and aligned with the model use-case. The intensity of the activities (i.e., the complexity of the metrics and number of metrics considered) should be differentiated across the MRR level, with more required for models with a higher MRR. Deviations from these expectations must be documented in the applicable Model Family Standards and will be considered on a case-by-case basis (e.g., if a model is only used once a year, such as for stress testing, there may be no value in requiring model monitoring).

Note, that since the main drivers of the MRR is materiality, if the proposal is to adopt limited annual ongoing monitoring, this must be combined with additional more frequent materiality monitoring to ensure that increased exposure or usage has not led to a higher MRR in the interim, which would cause the MRR to jump.

Due to the complex nature of modelling and differences across models in the various family types, each Model Family Standards must define requirements for ongoing monitoring of models within their scope, allowing for differentiation of intensity and frequency based on the level of MRR at the time of development.

This must include:

i. The function that will be performing the ongoing model monitoring and the Process Owner responsible for model monitoring (typically the Model Owner). Where not specified, the Process Owner for model monitoring will be assigned to the Model Owner.

ii. Objective of the ongoing monitoring, for example model performance, model stability, ongoing assessment of identified model risks.

iii. The selected criteria to be monitored (e.g., PV, risk, calibration failure, number of mis-use cases, etc) together with a rationale for selection. The selected criteria must be tangible, and observable on a frequency aligned with the objective of the ongoing monitoring requirement. The rationale for selection of the quantity to be monitored must be provided.

iv. Thresholds for success / fail criteria must be specified and, where possible and meaningful, augmented with intermediate early warning triggers (e.g., at 80% of the threshold), with a rationale for the levels provided. An explanation must be provided to explain why the levels are appropriate and effective in detecting the poor performance. For example, extremely tight tolerances around an estimate could result in large number of model failures which could be triggered by standard error of an estimate and is not indicative of poor performance. Similarly, extremely large thresholds that would never be triggered will not pick up poor performance. It is suggested that the choice of thresholds should be supported with analysis e.g., sensitivity analysis to determine the effect of shifting the thresholds up or down.

v. Frequency of monitoring to be performed. This must be aligned with the objective of the ongoing monitoring. For example, for a model used solely for the purpose on an annual stress test, it might be prudent to assess the model performance on a semi-annual basis. For a model used within financial market for hedging purposes, a daily or weekly monitoring frequency of the model accuracy (e.g., valuation adjustment or calibration failures) could be more appropriate.

vi. Reporting requirements. Each Model Family Standards must specify standards for reporting of ongoing-monitoring metrics for models within the model family, in a form easily accessible and understandable to a suitably qualified individual, to allow for consumption of results. This must include:

- a clear comparison of the observed quantities with thresholds,
- frequency of monitoring,
- the pass/fail outcome, and
- the next steps to be taken in the event of a breach.

The suitability of the reporting interval should take into consideration the frequency of ongoing monitoring and practical considerations (e.g., for daily monitoring monthly reporting may be suitable, for monthly monitoring, quarterly reporting may be suitable). The Process Owner is responsible for updating monitoring information in GAME.

vii. Review and challenge requirements. Model monitoring results must be signed-off by the Process Owner (or delegate) and shared with the Model Sponsor, Model Owner and GMV[21] on a periodic basis. The Model Owner (or delegate) and GMV are responsible for providing 1LOD and 2LOD effective challenge[22] to monitoring results and ensuring there is documented evidence of the review. The Model Owner (or delegate) is responsible for ensuring a summary of the model results, with particular focus on any areas of poor performance, is provided to the applicable DMA.

viii. Procedures to follow in the event of a monitoring fail outcome triggered by a threshold breach. Each Model Family Standard must specify requirements detailing the process to be followed for models within scope including, triggers for conducting root-cause analysis to identify model limitations where continual breaches are observed, and subsequent guidance to drive when recalibration or redevelopment is required.

[21] There may be instances where the 2LOD review and challenge role is performed by a team other than GMV for some model families. Where this is the case, it must be specified in the applicable Model Family Standards.

[22] Such review and challenge could be carried out by individuals or as part of a collective e.g., performance working group or committee with key stakeholders from 1LOD and 2LOD in attendance.

Any breaches of threshold must be escalated to the Model Sponsor to ensure awareness of model weaknesses, limitations and risks associated with model use in accordance with Section 5.6.

Process and Oversight

The Process Owner for model monitoring is responsible for ensuring that model monitoring has been carried out in line with the requirements specified in the applicable Model Family Standards [GMRP 2.12.1d].

Issue Management

Issues may be raised by GMV against ongoing model monitoring deficiencies in the same way that they are raised as part of independent validation work. Where additional modelling issues are identified in the ongoing monitoring process these must follow the standard issue management process detailed in Section 17.2, including documentation of the issue raised with appropriate severity, action plan and timelines for remediation from the issue owner. GMV is responsible for completing the issue template, with input from the 1LOD and Process Owner for model monitoring (e.g., to agree issue target date and action plans, and any additional compensating controls that may be required), and for recording it in GAME.

Issues may also be self-identified by 1LOD based on results from ongoing model monitoring. Where this occurs, they must discuss with GMV to agree the issue wording and follow the standard issue management process detailed in Section 17.2. In this instance the Model Owner (or delegate) is responsible for completing the issue template, uploading the completed template in GAME and recording the issue in GAME.

Where the introduction of model monitoring addresses issues raised as part of the MLC, the Model Owner is responsible for providing GMV with the necessary evidence to review as part of an issue closure pack for assessment and potential closure of the issue, in line with the standard issue closure process detailed in Section 17.4.1.

Model Risk Ratings

Where model monitoring results highlight a change in the Materiality Rating (e.g., from an increase or decrease in model usage) the Model Owner and GMV must discuss and agree the appropriate level of the Materiality Rating to be applied. GMV is responsible for ensuring the rating is updated in a timely manner, including an update to the MRR if required.

Where ongoing monitoring results highlight a change in the Uncertainty Rating (e.g., from a change in model performance or from event risk such as model misuse), the Model Owner and GMV must discuss and agree the appropriate level of the Uncertainty Rating to be applied. GMV is responsible for ensuring the rating is updated in a timely manner, including an update to the MRR if required.

Where there is any disagreement on the change to be applied to either the Materiality Rating or the Uncertainty Rating, this must be referred to the relevant Head of GMV (Traded Risk or Banking Book) for a final decision.

12. MODEL USAGE - MODEL RISK MITIGANTS

12.1 Introduction

Overview

Model risk mitigants may be used to address known modelling deficiencies or model performance issues and could include adjustments made as part of the model design process, model overlays applied post model output, restrictions on allowable model usage or other compensating controls.

Typical reasons for applying model risk mitigants are to address:

- Model Limitations
- Performance (e.g., to address aggressive estimation and provide conservativeness)
- Extreme changes in market conditions (e.g., regime shift)
- Changes in regulation (i.e., temporary mitigant until a model change is implemented)

12.2 In-Model Adjustments

In-model adjustments refer to those adjustments used to address known modelling limitations as part of the model construct, documented as part of the model documentation, and applied on a systematic basis. These could include adjustments to model input data, or adjustments applied to the processing layer (including the systematic use of expert judgement). The documentation should include a rationale linking the adjustment to the associated model limitation, and how those adjustments will be calculated over time. Such in-model adjustments are considered part of the model rather than a model overlay.

The application of in-model adjustments should not be used as a substitute for proper development work to address known modelling limitations. Where further development work could remove the need for adjustments the Model Developer and Model Owner are responsible for establishing clear remediation plans.

Where a model is part of a vertical or horizontal network, the impact of any in-model adjustments on other models in the network should also be considered (e.g., in terms of heightened model risk).

The Model Owner is responsible for ensuring that the use of any in-model adjustments is specified in the model documentation and recorded in GAME.

12.3 Model Overlays

In contrast to in-model adjustments, which are considered part of the model, model overlays refer to adjustments that are applied to the model output to address model limitations where risks and uncertainties are not adequately reflected in models or addressed as part of the model development process. These overrides are not part of the original model design.

The application of model overlays should not be used as a substitute for proper development work to address known modelling limitations. Where further development work could remove the need for adjustments the Model Developer and Model Owner are responsible for establishing clear remediation plans.

The process for applying Model Overlays will typically vary across model families. The Model Owner (or delegate) is responsible for ensuring the applicable Model Family Standard details the Model Overlay governance requirements applicable to in scope models including:

- roles responsible for the design and calculation of Model Overlays.
- roles[23] responsible for reviewing and challenging the calculation of Model Overlays.
- roles[24] responsible for approving the application or removal of Model Overlays.
- processes for reviewing existing Model Overlays, including frequency of such reviews.
- criteria for reduction or removal of Model Overlays.
- triggers for prolonged usage of Model Overlays to drive root-cause analysis, and guidance for driving redevelopment or recalibration.

The Overlay Process Owner[25] is accountable for ensuring that use of the Model Overlay has been carried out in line with approved Model Family Standards [GMRP 2.12.2e] and is recorded in GAME.

In practice we distinguish between two types of model overlays: Post Model Adjustments and Management Adjustments, and where applicable to a given model family the governance requirements for each must be specified in the Model Family Standards (particularly where different roles are responsible depending on the type of Model Overlay applied).

12.3.1 Post-Model Adjustments

Post-Model Adjustments ("PMA") refers to adjustments made to remedy an observed deficiency with an identified cause from within the model.

PMAs can be applied either to

- model inputs (e.g., adjusting parameters with known model impact), or
- directly to model outputs (e.g., by comparison with an alternative benchmark model)

Note: where a benchmark is directly used to adjust the model output (e.g., by means of a model output difference), and meets the model definition requirements in Section 3, it shall be considered a model, and requires validation and approval before it is used for the purposes of a model overlay. The overlay itself will still be documented in the PMA template.

Documentation, Review and Challenge

The processes for applying PMAs may vary across model families but the intended outcomes of each process should be similar and ensure that there is a clear rationale for the use of PMAs to compensate for model limitations, and that the approach for applying PMAs is suitable for their intended use.

All PMAs should be subject to an independent review with intensity commensurate to the materiality of the PMAs.

PMAs applied to models used in Pillar 1 and Pillar 2 calculations (including feeder models), or models with material impact on financial accounting disclosures (e.g., IFRS9), are subject to review and

[23] This could include specific functions (e.g., GMV, or subject matter experts) or committees.

[24] This could include individuals or committees. For materiality (3,4) models the approving authority must have the appropriate level of authority (e.g., senior management committee or individual(s))

[25] The Model Owner is assumed to be the Process Owner for the Overlay process unless otherwise documented in the Model Family Standard. Where the Overlay Process Owner is distinct, they are responsible for providing details to the Model Owner to ensure the Overlay process is accurately represented in the Model Family Standards.

challenge by Group Model Validation (GMV), with subsequent sign-off from the Model Approver prior to implementation.

PMAs applied to material models, with materiality 3 or 4, must be endorsed by the Model Sponsor [GMRP 2.12.2i].

PMA Documentation

Roles responsible for the design and calculation of the PMA must be specified in the applicable Model Family Standards. The PMA Process Owner (or delegate) must ensure the following information is documented on the PMA template:

- Rationale for the model overlay – this must explain why the overlay is needed and what limitation or issue it is addressing.
- Methodology – this must explain how the overlay is calculated, for example adjusting inputs or outputs direct, together with justification to support the chosen methodology for its intended use.
- Magnitude and Direction – this must explain the expected size and direction of the overlay, and whether it is possible to bound the overlay accurately. This must also explain the dynamic or static nature of the overlay to be applied (i.e., how the size is expected to vary through time).
- Impact – of applying PMAs should be made clear when model results are reported for use in decision making. Model results must be provided both with and without PMAs to allow for a transparent understanding of the impact.
- Controls[26] – this must explain how the PMA is subject to appropriate usage controls to ensure that no changes can be made to the approved overlay.
- Criteria[26] to determine when the PMA should be removed or reduced.
- Triggers[26] to drive root-cause analysis for prolonged usage of the PMA.
- For material models, endorsement from the Model Sponsor.

Review and Challenge

All PMAs are subject to independent review and challenge [GMRP 2.12.2f], with intensity commensurate with the materiality of the PMAs. Roles performing the review and subsequent approval must be specified in the applicable Model Family Standards.

Where PMAs are applied to models used in Pillar 1 and Pillar 2 calculations (including feeder models), or models with material impact on financial accounting disclosures (e.g., IFRS9), the review must be performed by GMV, with subsequent sign-off from the Model Approver prior to implementation.

The Process Owner for the PMA is responsible for ensuring the model overlay is documented on the standard PMA Template, maintained by MRPG. The level of detail provided in the template must be commensurate with the perceived level of model risk, as captured by the MRR – with more detail expected for higher MRR than for lower MRR – with requirements documented as part of the applicable Model Family Standards.

In cases where the PMA itself constitutes a model then the technique must be categorised as a model [GMRP 2.12.2g].

[26] Where applied consistently within a given model family this may be documented in the applicable Model Family Standard

At a minimum the scope of the review should include the following:

- Assessment of the continued relevance of the PMA for the use-case being considered (i.e., whether the overlay is still required).
- Conceptual soundness of the methodology adopted to ensure the underlying assumptions are relevant.
- Integrity of the data used to calculate the PMA is relevant for the intended use-case.
- Plausibility of the outputs (i.e., appropriateness of the size of the adjustment and whether it is conservative of aggressive (e.g., for increased model accuracy), considering both the relative and absolute impact.
- Review of the related model limitation that has given rise to the need for a PMA, and whether they are due to significant model deficiencies requiring remediation.

The outcome of a PMA review will be graded: Acceptable or Unacceptable [GMRP 2.12.2f], together with a rationale for the conclusion and the next steps required for approval (e.g., from the delegated model approver (DMA) or MRC).

The PMA Process Owner is responsible for ensuring the PMA related information is updated in GAME.

12.3.2 Management Adjustments

This refers to adjustments made to remedy an observed deficiency which cannot be traced to a specific issue within the model. Management Adjustments ("MA") are typically carried out by the Model Sponsor (or delegate) or Model Owner (or delegate) or Model Users, under the terms of the applicable model use processes and controls and calibrated to the expected model output based on a combination of qualitative and quantitative considerations. On occasion MAs could also be invoked by second line challenge functions.

MAs typically involve a significant degree of subjectivity (a distinguishing factor versus PMAs with quantitative foundations), based on a subject matter expert view and understanding of the expected model output and analysis supporting the size and direction of the proposed overlay.

Documentation, Review and Challenge

While we distinguish MAs versus PMAs, due to their expert judgement nature and no root-cause linkage back to a particular modelling feature, the expectations for documentation, review and challenge described in section 12.3.1 still apply and should be adopted.

Roles responsible for the design, calculation, review, and approval of the MA must be specified in the applicable Model Family Standard. Given the expert judgement nature of MAs, the review and challenge should be performed by identified subject matter experts[27]. Where the MA is derived from some form of model-based analysis, the expectation is that GMV is engaged as part of the review and challenge process.

The Process Owner(s) for the MA process is responsible for ensuring that there is a suitable review and challenge process, and that the review and challenge is documented in a suitable format.

[27] Review and challenge may be via suitably qualified individual(s) or via a committee challenge process.

12.3.3 Governance of Overlays

Where triggers for continued application of Model Overlays are breached, requiring a root-cause analysis, the outcome of this analysis must be shared with the Model Sponsor, Model Owner and GMV to determine if model redevelopment or recalibration is required, or if further validation work is required. The outcome and conclusion must be shared with the individual or committee responsible for the approval of application / removal of Model Overlays.

As part of the Annual Status Assessment process, PMAs and MAs applied to in scope models will be challenged for continued suitability, taking into consideration the trigger requirements specified in the applicable Model Family Standards. Where concerns on suitability are raised, these will be escalated to the Model Owner (plus the Model Sponsor for material models) for further consideration of whether model redevelopment or recalibration is required.

12.4 Restrictions on Model Usage

Where material weaknesses are identified as part of the model validation process the outcome of the validation and the approval process should consider whether to apply restrictions on the model usage as a mitigant where possible and meaningful. Such model usage restrictions should also be considered where errors are identified as part of the ongoing model performance monitoring process. Restrictions on model usage could include:

- Permitting the use of model only under strict controls or mitigants[28]
- Placing limits on the model's scope of usage or constraints on parameter requirements

Note, to address known model limitations, Model Developers may also propose restrictions on model usage as part of the model formulation, which must be documented in the TDD.

Model usage restrictions arising as mitigants to model validation, model approval or model performance must be recorded in GAME by MRM. Self-identified model restrictions specified in the TDD must be recorded in GAME by Model Developers.

13. MODEL USAGE – ANNUAL STATUS ASSESSMENT

13.1 Introduction

Overview

The Annual Status Assessment ("ASA") is an annual process, where each model within a given model family is assessed to determine whether it is still working as intended and if the existing validation activities are sufficient. The assessment could simply affirm previous validation and development work, suggest updates to previous validation or development activities, or call for additional validation or development activities.

13.2 Annual Status Assessment Process

Purpose

The ASA process is governed and coordinated by MRPG on an annual basis, to assess the health of models within a given model family by verifying [GMRP 2.12.3]:

[28] Note, models with material weaknesses issues are required to have compensating controls in place if approved for use.

- tiering methodology used to specify materiality and uncertainty ratings.
- materiality ratings, uncertainty ratings and model risk ratings applied to a given model.
- that issue severity categorization remains appropriate.
- that models continue to be fit for their approved usage and reside in a suitable production environment.

The process applies to all in-use models in the Group.

Governance and Execution

MRPG is responsible for initiating and coordinating the ASA process which will require input from GMV, Model Developers and Model Owners, with flexibility for involvement from Model Users, Model Sponsors, and other second line functions, where deemed necessary [GMRP 2.12.3b].

The process should be executed on an annual basis for each model family separately, and the outcome must be documented on a standard ASA template, maintained by MRPG. The ASA must include a list of major model changes since the time of the last ASA, and a list of dispensations and/or provisional approval that are relevant to all models in scope of the assessment.

Each ASA should aim to complete within one year of the previous year ASA completion date. The Global Head, Model Risk Management may approve extended timelines for ASA completion, considering the rationale for inability to meet timelines and perceived level of risk arising from the delays.

Where a given model family contains a large population of models it may prove necessary to break the model population into smaller sub-sets for ease of discussion, review, challenge, and documentation. The final model family ASA would be a concatenation of the sub-group ASA documents. Where models undergo an annual revalidation requirement, these models should be included in the scope of the ASA however reliance may be placed on the outcome of those validation activities.

i. Tiering Methodology

The specified methodologies for determining both model materiality and model uncertainty, as applicable to given set of models, within the Model Family Standard should be subject to critical review from both 1LOD Model Owner(s) and Model Developers and 2LOD review and challenge from GMV.

This should include: the suitability of the materiality measures and associated thresholds for the model types considered, the relevance of the uncertainty rating drivers; and the suitability of the data sources used, including the relevance and availability of the information used to determine both materiality and uncertainty ratings.

Where changes in methodology are required, the Model Owner (or delegate) is responsible for ensuring the applicable Model Family Standards are updated and presented to Global Head MRM for approval as part of an action arising from the ASA process. Following any change in methodology GMV is responsible for ensuring that the appropriate model risk ratings are updated in GAME.

ii. Materiality Ratings, Uncertainty Ratings and Model Risk Ratings

For each model the Materiality Rating (MR), Uncertainty Rating (UR) and Model Risk Rating (MRR), must be verified with input from GMV, Model Owners (or delegate) and other relevant stakeholders.

The MR is largely objective and based on the materiality classifications as specified in the applicable Model Family Standards, which must reflect the Group wide materiality guidelines (c.f. Section 16.2).

The UR must be assessed against the uncertainty rating guideline indicators (c.f. Section 16.3) and any additional requirements in the applicable Model Family Standards. While the model specification (MS) and model input data (MID) are often quite static, consideration must be given to whether there have been any changes in production environment (IOE), observed poor model performance (MP), or occurrence of event risk (ER), such as model misuse, or regulatory issues, which would cause the uncertainty rating to change.

Once the MR and UR are agreed, the MRR is determined by the MRR Matrix (c.f. Section 16.1). In the event of any disagreement the Head of GMV (Traded Risk or Banking Book) will have the final decision on the applicable rating.

All proposed changes to ratings must be recorded in the ASA report by MRPG against the Model ID, with a short rationale.

iii. Issue Severity categorization remains appropriate

For each model, the list of open issues must be verified by GMV, the Model Owner (or delegate), and any relevant stakeholder, to ensure that the issue severity (Material Weakness, Identified Concern, Immaterial) remains appropriate. The degree of review and challenge is expected to be aligned with the agreed MRR of the model, with more focus on the riskiest models (RR4) than the least risky models (RR1).

Consideration must be given to any new evidence that is available since the time of the validation (e.g., ongoing monitoring results, or additional controls, or remediation), which could change the severity rating or lead to issue closure.

All proposed changes to issue severity must be recorded in the ASA report by MRPG against the Model ID, with a short rationale.

iv. Models continue to be fit for their approved usage and reside in a suitable production environment

The Model Owner (or delegate) is responsible for ensuring that models are deployed in production environments that have been thoroughly tested for the intended model purposes. The continued suitability of the production environment must be re-confirmed annually by the Model Owner (or delegate) as part of the ASA, taking into consideration the requirements in Section 10.2 (Production Implementation). To facilitate this MRPG will provide guidance in the form of a checklist to be considered, and reliance may be placed on Group Tech Policy, IT Standards, and existing control processes (e.g., IT audit of applicable systems).

For each model there must be a verification by GMV and the Model Owner (or delegate), considering stakeholder feedback, that the model is still considered fit for the approved usage within the applicable business decision process(es). This includes verification that the underlying modelling assumptions remain valid for the intended use cases.

The degree of review and challenge is expected to be aligned with the agreed MRR and must include any new evidence that is available since the time of the validation (e.g., event risk, performance issues, etc), which could give rise to new model issues. The assessment must consider whether the continued use of model overlays (PMAs or Management Adjustments) is indicative of a flawed model and trigger the need for root-cause analysis leading to potential redevelopment or recalibration, or if revalidation needs to be brought forward to earlier than currently planned. Where concerns are raised on the continued application of the PMA this should be escalated to the Model Owner.

Any new issues identified, or concerns raised with model suitability must be recorded in the ASA report by MRPG against the Model ID, with a short rationale.

Conclusion

The conclusion of the ASA for a given model family will result in a completed ASA report which details:

- Summary of any changes to the materiality or uncertainty rating methodology.
- List of Model IDs with changes to MR, UR, MRR
- List of Model IDs with changes to issues severity categories
- List of Model IDs with additional issues or changes in Validation Outcome
- Any concerns on continued use of specific models including the production environment
- A table of associated actions, owners and timeframes for addressing the actions

MRPG will notify[29] the outcome from the ASA to the relevant DMA for consideration, distribute the final report to all relevant stakeholder and upload it in GAME.

Next Steps

The Model Validator is responsible for performing the following actions within one calendar month of distribution of the final ASA report.

- Recording any changes in MR, UR, and MRR in GAME.
- Where there has been a change in the MRR, reassess with the Model Owner:
    - the suitability of development and validation work previously conducted, and
    - the next revalidation date, with updates reflected in GAME.
- Where there are changes to issue severity rating, updating GAME and the TVR with the new rating, and if applicable, obtaining an update to the action plan from the Model Owner.
- Where it is determined that new model issues are required, follow the standard issue management process detailed in Section 17.
    - Where the introduction of a new issue, or change in existing issue severity, is such that it results in a change in the validation outcome, the TVR must be updated to reflect the new validation outcome. Where the update worsens the validation outcome, compared with the original validation outcome, the model must be presented for reapproval by the DMA.

The Model Owner is responsible for performing the following actions within one calendar month of distribution of the final ASA report:

- Any required updates arising from a change in materiality rating methodology or uncertainty rating methodology are made to the applicable Model Family Standards and presented to the Global Head MRM for approval.
- Where concerns are raised over the continued use of a model, determining an action plan to address concerns (e.g., compensating controls or major model change) and scheduling any new development work in GAME.

[29] If there is an additional regulatory requirement for a given model family (e.g., European Mark Infrastructure Regulation ("EMIR") for FM valuation models to be re-certified by a committee) this should be embedded in the appropriate Model Family Standard.

- Where concerns are raised over the production environment housing the models, determining an action plan with the production environment owner to address those concerns, including an assessment of whether interim compensating controls are required.

14. USE - MODEL CHANGE

14.1 Introduction

Overview

Once a model has been deployed to a production environment and is in use it may need to be changed, for example, due to changes in business or regulatory requirements, monitoring exceptions, improvements in mathematical specifications, re-calibration, changes in availability of data inputs, issues discovered as part of revalidation work or the Annual Status Assessment. Such a change is referred to as 'Model Change', which ultimately leads to a new version of the model being deployed to a production environment.

Scope of a model change includes a change in the model processing unit (algorithm), a change in the model inputs (data), a change in the model output (overlay), a change in the approved model usage (e.g., to new products, portfolios, or market segments), and it also includes where an approved model is moved from one technology platform to another (technology platform).

To avoid increasing model risk, model changes need to be carried out in a controlled and transparent manner, such that they are easily identified, regularly reported and auditable. The Model Owner must ensure that models reside in an environment that enables this process.

Note:

- Completely removing or retiring a model, including all versions of the model, from being in use within a production environment is a model decommission (c.f. Section 15). Decommission should not be confused with model change. A model change refers to either a major or minor model change and is an upgrade to the latest version of a model in use within a production environment, whereas decommission refers to removal of all versions of a model from being in use within a production environment.
- Changes to model outputs without changing the underlying model, could result in a new model overlay (as covered in Section 12) or a change to an existing approved overlay (the subject of Section 12).
- In cases where a model requires a frequent update, such as recalibration, the Model Owner may propose a suitable approach as part of the original model design, as captured in the TDD. Once this is approved, the update process would be followed as part of the original model formulation and is not viewed as a model change [GMRP 2.12.4f]. In such cases the Model Owner is responsible for ensuring that appropriate controls are in place together with a necessary level of transparency to ensure the update process is auditable. Any subsequent change to the update process as documented in the TDD would be considered a model change.
- Where this type of pre-approved update applies to all models in a model family it may be documented in the applicable Model Family Standards and cross referenced in the TDD.

14.2 Model Change Classifications

Group Level Definitions

Model changes are categorized internally as either major or minor, as follows [GMRP 2.12.4a].

Major changes are defined as non-negligible changes to the input data or processing unit or approved scope of applicability of the model, or any changes that are complex in nature. Such changes have the propensity to introduce additional model risk. This includes material changes arising in dynamic models, not meeting the requirements in 14.1 [GMRP 2.12.4f], (i.e., models able to adapt, recalibrate, or otherwise change autonomously in response to new inputs, where this is not documented as part of the model formulation with appropriate controls to ensure the update process is auditable). Major model changes are expected to go through the full model lifecycle for development, validation, and approval [GMRP 2.12.4d].

Minor changes are defined as, negligible changes to the input data or processing unit or approved scope of applicability of the model, and that are non-complex in nature. Minor changes are unlikely to introduce additional model risk. Notification and confirmation requirements are linked to the level of perceived model risk as captured by the model risk rating (MRR).

The Model Owner is responsible for defining criteria in the applicable MFS to determine if a model change is Major or Minor, with referral to the Model Validator for marginal cases [GMRP 2.12.4c]. Where there are any regulatory requirements relating to the classification of model changes, these will override the internal classification types. The Model Owner (or delegate) is responsible for communicating model changes to GMV in line with the requirements below. For all model changes a comparison of pre-change and post-change model outputs must be provided.

Category	Description	Approval & Notification Requirements
Major	• Non-negligible changes to the input data, processing unit, or approved scope of applicability of the model OR • Changes that are complex in nature	Standard Model Life Cycle (MLC) process for development, validation, and approval, with usual stakeholder involvement during the MLC. The developer documentation is required to be on the latest TDD template. Test results must include a comparison of the model output prior to the model change and post the model change.
Minor	• Negligible changes to the input data, processing unit, or approved scope of applicability of the model AND • Changes are not complex in nature	Internal signoff from the Model Owner or suitable delegate. Update to the existing TDD (there is no need to adopt the latest TDD template). Models with MRR RR1 require notification to GMV. Models with MRR RR2/RR3/RR4 require notification to GMV with confirmation from GMV on the Minor nature of the change. Both require a comparison of the pre-change and post-change model outputs to help justify the minor nature of the change.

Additional Considerations

The following must be considered during the classification:

- Nature of the model and nature of changes to the model, for example, if the model is used for RWA calculations what is the impact of the change to RWA, or models used for financial accounting disclosures.
- Impact on model materiality and/or model uncertainty – any change that would result in a change to a risk rating constitutes a major change.

- Impact on networked models – (i) horizontal networks: ensure that the change does not result in a misalignment with the other network models (ii) vertical networks: whether the change in an upstream model has an impact on a downstream model.
- The cumulative impact of previous minor changes – each minor change must consider all preceding minor change and whether the cumulative impact is such that the next minor change should instead be classified as a major change.

Since minor model changes are not subject to the MLC, the Model Owner is responsible for ensuring:

- The model change is implemented correctly, and the impact of the changes is understood and explainable as part of the internal signoff process.
- The monitoring framework is still suitable following the model change. Where a change in monitoring framework is required, this should be communicated to GMV for review and challenge, and MRPG for awareness.

Model Family Standards Requirements

The definitions relating to Major and Minor changes are defined in terms of negligible versus non-negligible impact on the components of the MLC and/or in terms of complexity of those changes. Since the nature of changes, frequency of changes, impact of changes, regulatory perspective on changes, etc. will vary per model type, further specificity is required at the level of the Model Family Standards.

Each Model Family Standards must specify:

- Quantitative and/or qualitative criteria for determining a change as either Major or Minor, taking into consideration the Group Definitions. This amounts to defining the terms “negligible” and “complex” as applicable to models within a given model family type. Where possible, objective quantitative criteria must be adopted.
- Any regulatory requirements relating to model change (e.g., pre-notification, pre-approval, or post notification) for applicable models within scope [GMRP 2.12.4b].
- Any delegated authority of the Model Owner responsible for the signoff of Minor model changes.

Escalation

Where there is disagreement on the classification of a model change as Major or Minor, the decision shall be referred to the relevant Head of GMV (Traded Risk or Banking Book) for a final decision.

14.3 Model Change Governance Process

Once a model change has been approved, in accordance with the approval requirements detailed in Group Standards Section 14.2, the Model Owner must ensure the approved model version is implemented to the production environment in a way so as to replace the existing version(s) of the model as intended by the scope of the model change. This version release is to be done in accordance with requirements detailed in Group Standards Section 10.

Where a model is upgraded to a new version the Model Owner is accountable for ensuring the model version description, as recorded in GAME, specifies the associated model changes relative to the prior version. Where there is a requirement to maintain multiple versions of a model in production concurrently, the Model Owner must ensure the model version descriptions specify the respective allowable scope for each in use model version, including the rational why different versions are required to co-exist in a production environment (e.g., due to different use cases being captured). Such information is vital to Model Users who need to understand the scope of use cases associated with each model version.

If there are relevant specific actions and timeframes regarding the use of an earlier version of a model (e.g., use of existing version pending the production release of new model version if roll-out occurs at different times across different platforms), this must be specified at the time of model approval (via restrictions) to allow for tracking of actions and associated timelines.

14.4 Version Control & Version History

Each version of a model must be recorded in GAME, accompanied by development documentation covering the version. All changes to the model must be recorded in the applicable TDD.

The Technical Development Document must contain a version history table capturing:

- The version number – with version 1.00 the "initial model". It is suggested that Minor changes are represented as +0.01, (e.g., v1.01, v1.02, etc), and Major changes are represented by the next whole number (e.g., v2.0, v3.0, etc).
- Developer Name – name of individual who performed the model change.
- Model Owner – name of the model owner.
- Reviewer – name of accountable individual providing sign-off for Minor changes.
- Date of Change – date the change was made to the model.
- Comments – describing the nature of the change with cross-reference to relevant sections.

Note:

i. Changes must be made to the official document stored in GAME to ensure that the inventory record version history reflects the evolution of the TDD.

ii. Version histories must not include any version changes internal to the development team, for example those resulting from drafting and internal reviews. Version histories only reflect final approved versions.

iii. Major model changes must be documented on the latest applicable TDD template.

iv. Minor model changes can be documented as updates to the existing TDD and do not need to migrate to the latest TDD template.

15. MODEL DECOMMISSION

15.1 Introduction

Overview

Decommission refers to ceasing use of a model, including all use cases and all versions, from all process. Reasons for decommissioning a model may include:

- The Group exiting a certain country or business segment in which the model is being used.
- Introduction of a new model to remediate deteriorating predictive power or overlap of usage with other models.
- No current or expected usage in the foreseeable future.
- Regulatory changes.

Badly planned and/or poorly executed decommissioning can result in residual model risk, such as, a group of users continuing to use an unsupported and/or unapproved model because they were not informed, or not made aware of how business decisions will be made going forward if the metric being used for those decisions is now no longer being produced.

Where it is decided to decommission a model, the Model Owner (or delegate) is responsible for documenting a decommission plan to ensure controlled and full decommission [GMRP 2.12.4g].

Note the key focus on decommission is ensuring that the model is not available for use in a production environment.

Decommission should not be confused with the model change process. For a model change, the model ID persists and the version changes (as an upgrade). It is the same model although with modified features. For a model decommission the model ID is listed as decommissioned and the model is not available for use in production.

Zero Usage Models

Maintaining models in production comes with an overhead in terms of ongoing model maintenance including, but not limited to; ongoing monitoring and revalidation requirements (including maintaining documentation and testing to latest policy standards), and inventory management.

Therefore, models with continued zero usage for a consecutive 12-month period, and with no expected usage in the foreseeable future must be considered for decommission by the Model Owner. The Model Owner is responsible for ensuring there is a mechanism in place for the tracking and reporting of models in production with zero usage and the period of inactivity.

Models with zero usage must be given a materiality rating of zero to allow for ease of tracking in the inventory.

15.2 Model Decommission

All impacted processes, users and systems must be considered and suitably managed during model decommissioning.

The timelines and actions to be taken must be set out and communicated by the Model Owner (or delegate) to key stakeholders including, the Model Sponsor, all respective Process Owners, Model Users, GMV and MRPG.

Where a batch of models are to be decommissioned at the same time in the same system with a common action, a single decommission submission may cover multiple models.

Model decommission approval is to be sought from the Head of MRPG (or delegate), post obtaining approvals from the Model Owner and Model Sponsor, by submitting the completed model decommission approval template. [GMRP 2.12.4h]. The Model Owner (or delegate) is responsible for uploading the decommission approval to GAME and ensuring the correct status of the model is reflected.

The Model Owner (or delegate) is responsible for uploading the decommission approval to GAME within 2 weeks of received approval from Head of MRPG (or delegate) and ensuring the correct status of the model is reflected via engagement with MRPG.

15.3 Model Reactivation

Where a model has been decommissioned in the past there may be a need to reactivate the model at some point due to changes in business or regulatory requirements. The Model Owner (or delegate) is responsible for initiating the Model Reactivation process.

By definition, a decommissioned model must have a previous GMV model validation and approval associated with it, otherwise it would be treated as a new model and follow the standard development, validation, and approval process.

As a first step the Model Owner (or delegate) is responsible for completing relevant sections of the Model Reactivation Template (provided by MRPG), including the rationale for the reactivation (e.g., business and/or regulatory requirements), the MRR of the model based on the expected materiality and uncertainty ratings, and the previous validation status of the model (acceptable, unacceptable, conditionally acceptable). The Model Owner (or delegate) must also document the following, any changes to the previous approval scope, any offline changes made to the model while decommissioned, any changes in data availability or quality, any new network risks likely to arise from reactivation, appropriateness of any previous compensating controls, and any changes to the production environment that would house the model. Once completed this must be sent to MRPG for consideration and notified to the Model Sponsor.

MRPG, in collaboration with GMV, are responsible for documenting the reactivation decision on the Model Reactivation Template to provide the necessary audit trail.

MRPG will assess the following criteria, either of which will trigger the need for a full revalidation:

- Where the MRR has moved from RR1 to a higher rating and the previous validation work was on a reduced (RR1) template
- Where the time since the last validation exceeds the policy requirements (e.g., 2Y for RR4), or any regulatory required frequency

If neither of these are triggered, MRPG will consult with to assess the following factors before reactivating the model:

- Approval scope – if not consistent with the reactivation usage this could trigger revalidation
- Unreviewed changes while decommissioned – if major this could trigger a revalidation
- Data – is this the same and still available or has there been a deterioration
- Network risk – are upstream feeder models still suitable for the reactivated model
- Compensating controls – any previously imposed and are they still able to be activated
- Implementation and Operating Environment – and change in production environment

The decision process must be documented on the Model Reactivation Template and signed off by the Model Owner, Model Sponsor and Head of MRPG (or respective delegates).

The above considerations could require further actions from the Model Owner, GMV and other control functions. Once completed (or if no actions are required) the model can be reactivated.

16. MODEL RISK RATINGS

16.1 Introduction

Overview

The main thing that distinguishes a tool from a model is the presence of uncertainty, primarily arising from assumptions made in the model formulation, giving rise to the potential for model risk. We attempt to capture this risk through a model risk rating (“MRR”), the level of which must increase with the materiality of the use case and with the level of uncertainty (to be defined in a more general sense in Section 16.3) within a given model.

The MRR is specified as a function of; (i) materiality of the use case, taking values [0,1,2,3,4], and (ii) uncertainty associated with the modelling approach and supporting infrastructure, taking values [A, B, C, D]. Here “1” is the lowest materiality for a model that is in use and “4” the highest, “A” the

lowest uncertainty and “D” the highest. The “0” materiality rating is reserved for models with zero usage[30].

Once the materiality and uncertainty ratings are specified, the MRR is derived deterministically from a two-dimensional matrix (materiality vs uncertainty) skewed so that materiality is the dominant driving factor.

The resulting MRR takes risk-rating values [RR1, RR2, RR3, RR4], where RR1 represents the lowest risk-rating and RR4 the highest.

MRR Matrix

The MRR matrix is shown below. Each row corresponds to a different level of materiality rating and each column a different level of uncertainty rating. We define “high materiality” models as those with materiality rating [3,4], and “low materiality” models are defined as those with materiality rating [1,2]. We define “high uncertainty” as those with uncertainty rating [C, D] and “low uncertainty” as those with uncertainty rating [A, B].

MRR Matrix			Uncertainty			
			High		Low	
			D	C	B	A
Materiality	High	4	RR4	RR4	RR3	RR2
		3	RR3	RR3	RR2	RR2
	Low	2	RR2	RR2	RR1	RR1
		1	RR2	RR1	RR1	RR1
Zero-usage		0	RR1	RR1	RR1	RR1

The MRR derived from the matrix must be viewed as a baseline measure based on estimates of materiality and uncertainty, taking into consideration any model risk mitigants applied as part of the design process but not those applied post model output as part of an overlay. Where it is believed there are other considerations not fully captured by the materiality and uncertainty dimensions (e.g., heightened risk due to regulatory requirements, or model output used as part of financial accounting disclosures, low reliance as part of a business process), adjustments are permissible with approval from the relevant Head of GMV (Traded Risk or Banking Book). Where such adjustments are to be applied for a suite of models within a given model family type, the adjustment must be documented as part of the approved applicable Model Family Standards.

MRR Usage

The MRR is used to determine the intensity and frequency of model risk management activities as part of the standard business process. For example,

- Development and validation intensity – models with higher risk rating are subject to more rigorous requirements than those with a lower risk rating).

[30] Zero-usage does not include models with zero net position/exposure due to offsetting values (e.g., a model that is in use should have a minimum materiality rating of “1”. The value “0” is reserved for zero usage models.

- Revalidation frequency – models with higher risk rating are subject to more frequent revalidation requirements.
- Monitoring requirements – models with higher risk rating are subject to more onerous monitoring requirements than those with lower risk rating.
- Model change management – confirmation of minor change classification required from GMV for MRR RR2/RR3/RR4.

The expectation is that each Model Family Standards clearly lays out the requirements for development, validation and monitoring for different model risk ratings in line with the expectations and principles defined in Sections 7, 8, and 11. Where there are additional regulatory requirements relating to intensity or frequency these will override the standard business requirements and must also be documented in the applicable Model Family Standards.
Where either the materiality rating or the uncertainty rating is modified, the MRR must be updated in a timely manner. Where the MRR has changed:

The Model Owner is responsible for ensuring:

- Intensity of the development work is appropriate, including the TDD used, as articulated in the applicable Model Family Standards, to make sure it is aligned with the new MRR.
- Next revalidation date remains correct as determined by the new MRR.
- Level of monitoring applied to the model is appropriate and in line with the requirements of the applicable Model Family Standards, as determined by the new MRR.

MRR's will be verified as part of the MRPG Annual Status Assessment process (Section 13) applied to each model family. We now consider the two components that comprise the MRR in more detail.

16.2 Materiality Rating

Overview

Model Risk must increase with the level of materiality associated with the given use case of a model. The model materiality rating (MR) is a gauge of the potential impact on the Group, Business or Function, if model uncertainty were to manifest.

Ratings Approach

Central materiality guidelines are provided below in terms of impact at a Group, Business or Function level and are used to promote overall consistency across the Group.

MODEL MATERIALITY RATING GUIDELINES	
Rating	**Group Level Guidelines**
4	Material impact at Group level.
3	Material impact at Business or Function level with Noticeable impact at Group level
2	Material impact at Business or Function level with No Noticeable impact at Group level.
1	Unlikely to have a Material impact at Business or Function level
0	Reserved for models with zero usage

The construct is based on the ranking of "material impact" vs "noticeable impact" vs "no noticeable impact" at either Group or Business/Function level. However, these guidelines are not objective enough

for direct application to individual models due to the idiosyncratic nature of models and use-case across the Group.

Therefore, each Model Family Standards is required to identify the most appropriate measures of materiality rating for a given model type (or sub-type), for the use case being considered and define thresholds to be used to assign materiality to the bucket levels [1, 2, 3, 4], to define the impact at Group level and Business/Function level. The choice of thresholds must take into consideration the Group Level Guidelines above. Where there are multiple drivers of materiality rating, $(MR_i)_{i=1,\dots n}$ for a given model use case, each driver (within reason) should be considered in isolation with appropriate thresholds defined, and a final rating constructed from these accordingly. A conservative approach would be to use the largest, $MR = \max_{i=1,\dots n}(MR_i)$, although other approaches may be acceptable if supported with a sound rationale. For example, for a valuation model used within financial markets for hedging purposes, PV and Risk are both appropriate measures of materiality. The choice of materiality metrics and thresholds must be justified in the applicable Model Family Standards. Each Model Family Standards must also specify the data source(s) used to determine the applicable materiality rating measures.

In addition to the Group Level Guidelines, when designing materiality metrics, the following qualitative criteria must be taken into consideration:

i. *Reliance on the model*: This relates to the importance of a model in relation to informing business decisions). Low reliance could include a model only used for benchmarking purposes, whereas high reliance would include a model that impacts financial accounts. Low reliance models would carry less weight than high reliance models.

ii. *Model purpose*: For example, usage for financial accounts, capital, or risk. Models used for capital calculation would generally have a higher impact and hence weighting than those used for internal risk management purposes. Similarly, consideration should be given to the potential impact on the firm's solvency and financial performance.

iii. *Model coverage*: The scope of coverage of the model usage, for example, products and portfolios. Models with a large scope of coverage would generally have a higher weighting than those with a low scope of coverage.

iv. *Materiality as part of a larger model network:* The ability of the materiality metric to take consideration the interconnectedness of various component models.

Review and Challenge of Materiality Definitions

The appropriateness of the materiality metrics and associated thresholds within a given model family should be re-verified as part of the Annual Status Assessment process for the applicable model family to ensure the continued relevance and accuracy. This should include: the suitability of the data source used, including an assessment of the relevance and availability of the information to determine the materiality rating; and the accuracy of recording and maintenance of materiality ratings in the model inventory. The assessment should include both a 1LOD Model Owner/Developer view with review and challenge from 2LOD Group Model Validation. Where changes are required, the Model Owner (or delegate) is responsible for ensuring the applicable Model Family Standards are updated and presented to Global Head MRM for approval.

Rating Assignments

The model materiality rating must be assigned objectively by the Model Owner (or delegate) based on the materiality definitions and thresholds defined in the applicable Model Family Standards [GMRP 2.5a].

For a new model the Model Owner, taking into consideration input from the Model Developer, must estimate the materiality as part of the terms of reference discussion with the Model Sponsor, or soon thereafter. Where there is no current usage, this must consider the higher of (i) forecast materiality of use over the next one-year period and (ii) actual materiality of use (e.g., where the new model is a replacement to an existing once, or there are similar models in production). On completion of the development process the Model Owner must also re-confirm or update the materiality rating in the technical development document (TDD) and record it in the GAME, prior to the final submission to GMV.

Following the model submission for validation, GMV will challenge the materiality rating and confirm accuracy before commencing the validation work. The materiality rating assessment must be documented in the technical validation report (TVR). Where a different materiality rating is required, the Model Owner is responsible for ensuring this is updated in the technical developer document (TDD) by the Model Developer and GMV is responsible for updating GAME. Escalations arising from a disagreement on the materiality rating must be referred to the Global Head of GMV for a final decision.

Once the model is in production and in use, the Model Owner is responsible for ensuring that the rating for an existing model is refreshed in a timely manner whenever there is new information about the materiality of the model (e.g. increased portfolio size or trading activity), and at least quarterly. If the refresh leads to a change in materiality rating, the Model Owner (or delegate) is responsible for updating the materiality rating record in GAME and notifying MRPG.

Materiality ratings will also be verified as part of the MRPG Annual Status Assessment process (c.f. Section 13) applied to each model family.

16.3 Uncertainty Rating

Overview

Model Risk must increase with the level of materiality and uncertainty embedded in the model. The model uncertainty rating (UR) is intended to reflect the inherent uncertainty or risk in various constituent parts of the model construct. For example, risk arising from the model specification including numerical or statistical routines, risk arising from the input data for the model, implementation risks relating to supporting infrastructure (EUCs vs Controlled library), and risks arising from known or observed model performance issue.

Motivation

The motivation behind the identification of the chosen risk factors for the UR, is as follows. A model is comprised of inputs and a processing unit (or algorithm) which combine to produce a model output. In functional form we would write:

$$\boldsymbol{Model\ Output} = \boldsymbol{f}(\boldsymbol{Inputs}, \boldsymbol{Algorithm})$$

so that uncertainty associated with either the inputs or algorithm itself will lead to uncertainty in the final model output. To capture these risks, we introduce the components; “Model Specification” and “Model Input Data”.

Once the model has been developed, it is placed within a production environment (implementation phase). Implementation and operational (control) risks exist in relation to the nature of the environment the model is embedded, for example a legacy unsupported system, or a spreadsheet carry more risk than a secure code repository with ongoing support. The former could lead to heightened possibilities for unauthorized changes to models or their data. Similarly, use of models from a third-party library carries heightened implementation risk due to lack of transparency and control over source code. To capture this risk we introduce the component, “Implementation and Operating Environment”.

Following the release of a model to production, the performance may be assessed over time based on certain criteria, e.g., comparison with benchmark models, observed historical data, or user feedback. Where possible, performance risks must also be highlighted as part of the development process. For example, where modelling assumptions would give rise to known undesirable but unavoidable modelling features, or where development testing results in observed poor performance outcomes. To capture this risk, we introduce the component “Model Performance”.

Finally, there are certain risk events which are generally not observable or known at the time a model is developed or released to production for use. Examples include, but are not limited to; model misuse, changes in business environment, or loss of regulatory approval. To capture these risks, we introduce a generic “Event Risk” risk component, with default setting of “A”. On occurrence of such an event the “Event Risk” component would be raised accordingly as a penalty function to reflect the risk. For those models which form the basis of a regulatory approval, the potential for loss of model approval and proportional impact of the model should be taken into consideration.

Rating Approach

The Uncertainty Rating UR is decomposed into 5 constituent driving components to reflect the following:

- Model Specification (MS)
- Model Input Data (MID)
- Implementation and Operating Environment (IOE)
- Model Performance (MP)
- Event Risk (ER) [default value “A”]

Each component is assigned a value from [A, B, C, D], where A is the lowest and D the highest. Following completion of this assignment the overall Model Uncertainty Rating is determined as the maximum of the component [A, B, C, D]:

$$\mathbf{UR} = \max_{A,B,C,D}(\mathrm{MS}, \mathrm{MID}, \mathrm{IOE}, \mathrm{MP}, \mathrm{ER})$$

where we take the liberty of assigning A<B<C<D.

The uncertainty rating must consider the effect of any compensating controls incorporated in the end-to-end model design and model control framework and will therefore gauge the residual model risk rather than the raw model risk. Note, where this is used to reduce the uncertainty rating of a component a clear rationale must be provided relating the “raw” UR to the “residual” UR via the mitigating actions.

The rating must be assigned without considering any future management actions such as the closure of issues arising from independent validations. If the residual model uncertainty has been reduced due to issue closure, then the uncertainty rating must be refreshed.

Group level Uncertainty Rating Definitions are specified below:

UNCERTAINTY RATING DEFINITIONS	
Component	**Description**
Model Specification (MS)	This captures the uncertainty in the model output due to the algorithm or processing component of the model and includes both the design consideration (conceptual soundness) as well as the proposed implementation which utilizes various numerical or statistical routines. Every model is an approximation based on a set of underlying assumptions, which generally have limitations that could lead to uncertainty in model output. The conceptual soundness of the modelling choice and the use of market standard models must be considered when assessing the uncertainty risks in the algorithm. The use of numerical or statistical routines as part of the model construct must be considered, both in terms of appropriateness of the routines and any in-built limitations. Model uncertainty generally increases with the complexity of the algorithms used. Where there are areas of subjectivity applied to the model construct this will increase the uncertainty in the overall modelling solution.
Model Input Data (MID)	This captures the uncertainty in the model output due to the input data component of the model and includes both data integrity and data quality considerations. Data integrity includes the availability of the data as well as the representativeness of the data as appropriate to the model use case and must be assessed as part of model development. Data availability may change over time. The nature of the data that is used to run the model in production must be consistent with the nature of the data that the model was designed to use. Where the data is not representative of the use case there is heightened uncertainty in the model output. Data quality refers to the timeliness, accuracy and completeness of data used to run the model and must be assessed as part of the development process. Consideration must be given to the operational risks from manual processes and whether sufficient controls are in place to mitigate issues. The use of subjective criteria to determine data values e.g., subject matter expertise will lead to an increase in uncertainty. Increased complexity, including the use of unstructured and/or interconnected data sources, and size of data will both lead to an increase in uncertainty.
Implementation and Operating Environment (IOE)	This refers to the production system(s) and associated operating (control) processes that the model is embedded within, including sub-systems used to provide inputs or process and store outputs as part of the end-to-end solution. Uncertainty increases if the environment is unstable, unsupported and/or can be accessed and changed (algorithm or data) without proper authorization. Where there is limited access to systems and code (e.g., Third-Party systems), the uncertainty will increase.
Model Performance (MP)	Model performance refers to the observed ability of the model to accurately predict when compared against appropriate metrics, and/or whether the development assumptions remain valid and realistic over time. Where possible, model performance testing must be performed as part of the development phase, and areas of weakness and uncertainty identified. The proposed use of inappropriate metrics and/or thresholds to determine model performance outcome will lead to increased uncertainty of model output. Where no performance issues have been highlighted as part of the development cycle, and there are no reasons to believe issues exist, the default rating of “A” would typically be applied. However, this may change over time in relation to model performance monitoring activities and observed breaches of thresholds.

UNCERTAINTY RATING DEFINITIONS	
Component	**Description**
Event Risk (ER)	This represents a catch-all penalty function for those risks that are generally not observable or known at the time a model is developed or released to production for use. This includes, but is not limited to model misuse, changes in business environment, or loss of regulatory approval. Misuse refers to when a model is not used in accordance with the purpose, scope, limitations, or restrictions of use, etc. Changes in business environment refers to the context in which the model is used for business decision making purposes, which could impact the model's relevance and applicability. Since neither of these risks are observable at the time of development, a default rating of "A" is typically applied. However, this may change over time as events materialize and the rating will be increased to reflect these events. For models which form the basis of a regulatory approval, the uncertainty rating must reflect the potential for the model to result in the loss of approval or in punitive capital multipliers. The ER rating must be set as to take into consideration the proportionate effect of the model on this approval.

Uncertainty Rating Assignment Guidance

Due to the complex nature of modelling and differences across models in the various family types, it is impossible to define a purely rules-based approach for assigning uncertainty ratings [A, B, C, D]. Instead, we provide guidance, in the form of indicators which must be considered when assigning a given level of uncertainty to each of the constitute components in the UR. Each Model Family Standards must specify the way in which the guidelines are applied to models within a given family (or sub-family) type.

Uncertainty Rating Assignment Guidance	
Model Specification Indicators	
A	• Modelling algorithm is simple. • No modelling assumptions or a small number of well understood modelling assumptions. • De minimis uncertainty expected in relation to the model output. • No use of expert judgment.
B	• Modelling algorithm is of low complexity (e.g., market observable pricing, 1D Monte Carlo). • Modelling in line with industry standards. • Standard modelling assumptions, resulting in well understood and controlled model limitations. • Minor use of expert judgement with no noticeable impact on model outcome.
C	• Modelling algorithm is of medium complexity (e.g., low dimensional Monte Carlo). • Some industry consensus pricing but with different approaches possible. • Increased use of questionable modelling assumptions to which the model is highly sensitive. • Increased use of expert judgment with noticeable impact on model output.
D	• Extremely complex model (e.g., high dimensional Monte Carlo, complex calibration etc) • Large number of unsupported model assumptions. • Highly non-standard modelling compared with industry. • Extreme use of subject matter criteria with material impact on model output.
Model Input Data	
A	• Data is available and is representative and suitable for the use case. • Data is accurate and complete with no gaps. • Data is observable with no use of expert judgment to determine values. • Data structures are not overly large or complex in nature
B	• Development Data is not fully representative, differences are minimal with no material impact. • Data is incomplete with minor gaps or minor inaccuracies but is still deemed appropriate to use with no material impact. • Limited use of expert judgment to determine data values with no material impact on model output

	• Data structures are not overly large or complex in nature
C	• Data is not fully representative, with substantial differences and potential for material impact. • Data is incomplete with substantial gaps or inaccuracies with clear data quality issues and potential for material impact, • Noticeable use of expert judgment to determine data with potential for material impact. • Data structures are large or complex in nature
D	• Data is not available or is highly unrepresentative or is not suitable for the use case. • Data exhibits large gaps, or large number of observed inaccuracies with potential to jeopardize the integrity of model output. • Significant use of expert judgment to determine data values materially impacting model output. • Data structure is very large or very complex in nature
Implementation and Operating Environment	
A	• Model is implemented in a stable environment with full support and no indication of unauthorized access to either data or code. • Model is not implemented in an EUC. • Model is not from a third-party .
B	• Model implementation environment demonstrates minor episodes of instability, partial support or unauthorized access with no material impact. • Model is implemented in a registered EUC either wholly or partially, with no observed issues. • Model is from a third-party and there have been no identified issues.
C	• Model implementation environment demonstrates significant amount of instability, partial support or unauthorized access with potential for material impact. • Model is implemented in a registered EUC, either wholly or partially, with observed issues. • Model is from a third-party with identified potential issues which could have a material impact.
D	• Model is implemented in an environment which is unstable or has no proper support or is prone to unauthorized access. • Model is implemented in an unregistered EUC. • Model is from a third-party and identified issues have resulted in a material impact
Model Performance	
Note	• At the time of development, assuming appropriate model monitoring metrics and thresholds are in place, if there are no performance issues the default value would be “A”, which might change over time.
A	• Model is performing well, and performance monitoring indicates no issues. • Metrics and thresholds are appropriate for capturing model performance
B	• Model is generally performing well, with intermittent performance issues or deterioration observed. • Metrics and thresholds appear to be reasonable but additional support required.
C	• The model performance is considered weak and/or there is a persistent deterioration in model performance. • Metrics and thresholds are questionable with limited support provided.
D	• Model monitoring shows persistent poor performance and material inability of the model to accurately predict. • Metrics and thresholds are not appropriate for capturing model performance.
Event Risk (Penalty Function)	
Note	• Regulatory Risk must be set based on the potential for the model to result in the loss of regulatory approval or in punitive capital multipliers considering the proportionate effect of the model on the approval. • Other Event Risks (excluding Regulatory Risk) are typically unknown at the time of development and the default value of “A” is typically assigned.
A	• No episode of event occurrence (e.g., no misuse, no change in business environment).
B	• Limited episodes of event occurrence (e.g., low frequency of misuse, minor shift in business environment)
C	• Frequent episodes of event occurrence (e.g., repeated instances of misuse, material shift in business environment)

D	• Continual event occurrence (e.g., continual misuse, material change in business environment).

In addition to the individual slotting criteria specified above, the following generic considerations should also be applied:

Uncertainty as part of a larger model network: additional uncertainty introduced from the interconnectedness from models as part of a horizontal or vertical network.

Review and Challenge of identified Uncertainty Ratings

The appropriateness of the set of criteria identified as relevant to a given model family should be re-verified as part of the Annual Status Assessment process for the applicable model family to ensure the continued relevance and accuracy. This should include: the suitability of the data source used, including an assessment of the relevance and availability of the information to determine the uncertainty rating; and the accuracy of recording and maintenance of the uncertainty ratings in the model inventory. The assessment should include both a 1LOD Model Owner/Developer view with review and challenge from 2LOD Group Model Validation. Where changes are required, the Model Owner (or delegate) is responsible for ensuring the applicable Model Family Standards are updated and presented to Global Head MRM for approval.

Rating Assignments

As part of the terms of reference phase the Model Owner, taking into consideration input from the Model Developer, must estimate the uncertainty rating of each model component using the Group level uncertainty rating definitions and assignment guidelines criteria (Section 16.3), on a best effort basis taking into consideration the proposed modelling approach [GMRP 2.5b]. On completion of the development process, the Model Owner must also reconfirm or update the uncertainty rating in the TDD and record the estimate in GAME, prior to the final submission to GMV, to reflect any new findings observed during development, e.g., poor performance, data quality or data integrity issues, compensating controls or model adjustments, etc.

The uncertainty rating for each model must be assigned objectively, based on the model risks after considering any compensating controls or adjustments that might have been incorporated as part of the model design process (i.e., as part of the model construct, not those applied post model output as part of an overlay process).

Following the model submission for validation, GMV will challenge the uncertainty rating and confirm accuracy, before commencing the validation work. The challenge must also consider the appropriateness and effectiveness of any compensating controls built into the model design used to justify a reduction of the uncertainty rating. The uncertainty rating assessment must be documented in the TVR. Where a different uncertainty rating is required, the Model Owner is responsible for ensuring this is updated in the technical developer document (TDD) by the Model Developer and GMV is responsible for updating GAME. Escalations arising from a disagreement on the uncertainty rating must be referred to the Global Head of GMV for a final decision.

The rating for an existing model must be refreshed whenever there is new information about the uncertainty of the model, for example model monitoring exceptions, or observed issues with data. If there is a change in uncertainty rating, this must be notified by the party proposing the change to GMV for assessment. GMV is then responsible for updating the uncertainty rating record in the GAME and notifying the Model Owner and MRPG.

Uncertainty ratings will be verified as part of the MRPG Annual Status Assessment process (Section 13) applied to each model family.

17. MODEL ISSUE MANAGEMENT

17.1 Introduction

Overview

Model issues must be raised where deficiencies are observed during MRM activities, including (re)validation, implementation, use or monitoring to address areas of realized or perceived model risk. Issues can result in a delay in model approval or restrictions being placed on the continued use of an already approved model. Model issues may also be raised outside of the usual MRM activities, for example in relation to regulatory, internal, or external audits.

Issues that remain open following the completion of the MRM activities must be recorded in GAME. This does not apply to transient issues that may have been opened and subsequently closed by additional information or actions during the MRM activity. For example, when performing a validation review it is common to identify preliminary issues which are subsequently closed by the time the TVR is finalized.

17.2 Model Issue Management Process

Raising Issues

While issues are typically raised as part of the model (re)validation process, they can be raised at any point in the model life cycle. This includes, but is not limited to, the following:

- Model Development
- Model Validation / Revalidation
- Implementation
- Model Use
- Ongoing Monitoring
- Annual Status Assessment

In addition, model related issues may be raised outside of model life cycle. This includes, but is not limited to, the following:

- Internal Audit
- External Audit
- Regulatory Audit

Such issues have their own governance processes in relation to issue closure (e.g., regulatory issues can only be closed by the associated regulator).

17.2.1 Issues raised as part of the model life cycle

Where issues are identified as part of 2LoD processes, (Model Validation / Revalidation, or Annual Status Assessment), GMV[31] is responsible for raising the issue. Where issues are identified as part of the 1LoD processes (Model Development, Implementation, Model Use or Ongoing Monitoring), the Model Owner (or delegate) is responsible for raising the issues with engagement and oversight from GMV to ensure the appropriate level of issue severity, suitability of action plans and remediation timeframes.

[31] There may be instances where MRPG also raise issues e.g., in relation to policy requirements.

Issues are usually raised in relation to a particular aspect of a model rather than on the entire model. We refer to such aspects as “segments” of the model and could relate to the entire model or a subset of the model e.g., a particular use case, a portfolio or product, a currency etc. In this way we are potentially able to isolate the issue impact and apply compensating controls or restrictions in relation to certain segments.

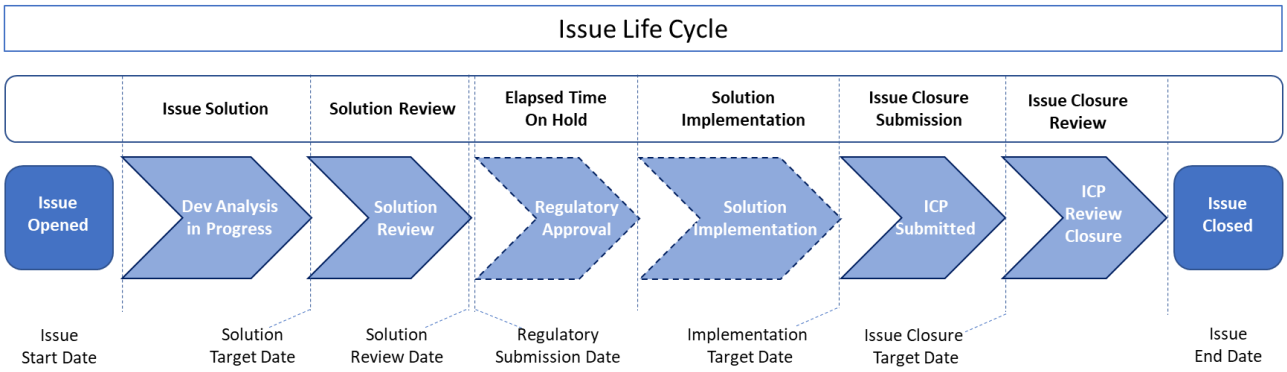
Every issue must have an Issue Owner, which is typically the Model Owner (or delegate in the form of the appropriate model developer or model manager), although other issues owners are possible[32]. The individual raising the issue is responsible for engaging with the proposed issue owner to agree on the ownership of the issue.

When an issue is raised, the issue owner is responsible for defining an action plan with a target date for completion in a timely manner. The issue owner is responsible for the end-to-end remediation of the issue, even though certain sub-actions of the remediation may involve other parties. The Model Sponsor is ultimately accountable for the issue and the associated model risk.

Issue Life Cycle

Similar to the Model Life Cycle, there is a natural life cycle related to an issue from issue initiation at the start of the issue, the development of an issue solution, the review of that solution, for models requiring regulatory approval a regulatory submission, implementation of the solution in a production environment and finally full issue closure.

A typical Issue Life Cycle is shown below.



Note an issue is not considered as closed until the associated model risk arising from the issue has been remediated. Therefore, even if a solution has been developed and reviewed the issue may not be remediated if there is regulatory approval required and/or subsequent implementation required. Similarly, there may be issues where those two stages are not relevant e.g., pure documentation issues.

[32] For example, where an issue is comprised of a number of actions, some of which are outside the Model Owner(s) responsibility it would be natural to assign the issue to the party with the most actions to deliver, however the Model Sponsor remains accountable for timely and effective issue remediation.

Issue Taxonomy

Issues are associated with weaknesses observed in the model life cycle, and as such may be associated with a standard taxonomy. Each issue must be assigned a risk category as follows:

Issue Type	Description
Model Specification	The issue relates to the processing component of the model including but not limited to the technical specification, mathematical construct, numerical and statistical routines (e.g., regression, finite difference, interpolation, extrapolation etc.) as well concerns in relation to evidence provided in support of the model (e.g., limited, or missing developer testing). Concerns with model specification could be linked to conceptual soundness issues with the model.
Mode Input Data	The issue relates to data quality or data integrity component of the model, including representativeness.
Model Output	The issue relates to the output of the model, not already captured by the Model Specification or the Data issue categories. For example, this could relate to concerns on the reliability of the model output, issues with post model adjustments or any applied overlays.
Implementation and Operating Environment	The issue relates to implementation of the model or the ongoing operation of the model within a production environment, including the specification and operational aspects of any controls or mitigants.
Model Performance	The issue relates to the ongoing model performance, typically manifested through a breach of agreed thresholds, or where the metrics proposed (both criteria to be monitored or the thresholds proposed) have issues.
Model Usage	The issue relates to the usage of the model e.g., the appropriate use-case or scope of application of the model (portfolios, markets, currencies etc.)
Regulatory Compliance	The issue relates to a regulatory requirement. Note: where there is overlap between the categorization of regulatory compliance and the other categories, the issue must be classified as regulatory compliance.
Documentation	This relates to pure documentation issues, with no impact on the model itself. I.e., fixing a documentation issue will not change the model. For example, if there was a typo in the documentation of the model specification this would be treated as a documentation issue, since it does not change the actual model that has been implemented and tested. Note: Documentation Issues have their own severity classification and remediation timelines.

Where an issue spans multiple dimensions, a “best-fit” approach should be adopted on a conservative basis. For example, if there is lack of support provided in support of the model and the Model Validator has resulting concerns on the modelling approach, this could potentially be a model specification issue or a model documentation issue. In this instance a conservative choice would be model specification, since there are concerns that relate to the model itself. In practice the Model Validator should consider what the required fix will entail, as this will often determine the applicable risk category.

Issue Severity

Each issue raised must have a severity rating attached to it, which will be associated with a particular "segment" of the model as identified in the model description. There are 3 possible severity categories, defined as; Material Weakness, Identified Concern, or Immaterial.

Separate guidance is provided below in relation to non-documentation issues and documentation issue severity levels.

Non-Documentation Issue Severity	
Issue Severity	**Description**
Material Weakness	Material weaknesses arise when there is a demonstrated inaccuracy or unreliability in a segment of the model, ***or*** where there are major flaws related to the model specification (including assumptions and conceptual soundness matters), modelling data, implementation, performance, or model usage. ***And*** There is a non-negligible financial impact on model output[33] **In addition** Any material breach of regulatory compliance requirements will be labelled a material weakness. Examples include: • material model performance issue • material breaches in relation to Group or Model Family Standards requirements • major model design issues without acceptable justification • material breach of regulatory requirements • an issue which has been specifically raised by regulators. Note: where a material weakness is raised as part of the validation or revalidation process, and impacts a sufficiently large segment of the model, or where there are a number of material weakness issues that on aggregate impact a sufficiently large segment, so as to make the use-case unreliable, this may result in an Unacceptable model outcome and potential rejection of the model for use.
Identified Concern	Identified concerns arise when an issue on a model segment presents a meaningful risk which, although not currently deemed a material weakness, could lead to a material weakness at some point in the future, or where the demonstrated impact of the issue is noticeable but will not have a material impact on the modelling outcome. This could arise where there are weaknesses related to the model specification, modelling data, implementation, performance, or model usage, with noticeable but limited impact on the model output. Examples include: • design issues where the justification is weak or based on unsupported assumptions. • breaches in relation to Group or Model Family Standards requirements with noticeable but limited impact on model output.

[33] For models that do not produce a financial output, this should be interpreted in relation to the materiality of the impact on the process that the model is used within.

Non-Documentation Issue Severity	
Issue Severity	**Description**
	• demonstrated inaccuracy, which would have resulted in a material weakness, but the impact is not currently material. Note: a lack of conceptual soundness would always be considered a major flaw rather than a minor weakness, and hence potentially lead to a material weakness
Immaterial	Immaterial issues are those with no discernible impact on the model output or reliability for the use-case(s) being considered both currently and in the foreseeable future. Examples include: • purely technical breaches with internal requirements that have no impact on model output. • demonstrated inaccuracy with negligible impact. Note: where an issue is currently immaterial with the possibility of becoming material in the future, ongoing monitoring must be implemented as an issue mitigant to ensure transparency.

Documentation Issue Severity	
Severity Category	**Description**
Material Weakness	Material Weaknesses are defined as major gaps in documentation which when considered on aggregate could reasonably be expected to impact the veracity of the validation outcome. In such circumstances a prudent validation outcome will be adopted with one potential outcome being an unacceptable model. At a minimum there will be a requirement to redocument the model on the latest TDD template and address the material gaps within 6 months. Examples include, but are not limited to: • Major gaps in relation to the model methodology such that the validator is unable to determine how the model functions (and hence unable to assess the model). • Major gaps in relation to the model input data such that the validator is unable to determine how data is consumed and processed by the model (and hence unable to assess how the models is operating). • Major gaps in documentation of model development testing to support the model such that the validator cannot conclude that the model meets its objective for its intended scope of use. • As applicable to models subject to regulatory requirements, major gaps in the documentation of the regulatory self-assessment such that the validator reasonably believes could relate to a material regulatory non-compliance issue. Note: the expectation is that such issues would have been identified as part of the gating mechanism when assessing the model submission. However, in practice it is often the case that detailed missing information only becomes apparent when a deeper dive into the model construct is performed.
Identified Concern	Identified concerns are defined as significant gaps in documentation, vital in gaining a full understanding of the model, but when considered in aggregate are not expected to impact the veracity of the validation outcome. Such gaps require remediation within 6 months and may be documented in the existing TDD or under the latest TDD.

Documentation Issue Severity	
Severity Category	**Description**
	The key requirement is that the missing information is still vital to understanding the model but that it is not expected to alter the validation outcome. Examples include: • Missing documentation sections when compared against the latest TDD template, (e.g., due to legacy templates) with no discernible impact on the validation outcome. • Significant gaps in the justification provided in relation to the model selection process where it is not expected to change the chosen model. • Significant gaps in documentation of input data, without impact on the validators understanding of how the model consumes and utilizes the data or ability to assess the operation of the model. • Significant gaps in documentation of model methodology without impact on the validators understanding of how the model functions or ability to assess. • Significant gaps in documentation of mandatory testing requirements without justification (c.f. GMRS validation section 8.3.1)
Immaterial	Immaterial issues are defined as immaterial documentation weaknesses which are not vital in gaining a full understanding of the model and its performance. The key requirement is that the missing information is still not deemed vital to understanding the model. Examples include: • Clarifications • Additional details and explanations. Minor missing details on the input, model methodology or output of the model with no impact on the understanding of the model.

Where a potential Material Weakness is observed, it must be communicated by the observer to all stakeholders (e.g., Model Sponsor, Model Owner, Control Functions) as soon as is practically possible to provide transparency and allow for remediation planning. This will typically be in the form of a short meeting to discuss model issue findings.

The Issue Owner is responsible for ensuring that all material weaknesses have suitable compensating controls in place to mitigate the risks until a model solution is provided by completing action plans.

Compensating Controls

Where an issue is a material weakness the issue owner is responsible for specifying, agreeing, and implementing adequate compensating controls to mitigate the model risk until the action plan is addressed. Compensating controls are actions that help to mitigate the identified modelling issues and give comfort on the usage of the model while the root-cause of the issue is being addressed. GMV must be engaged by the issue owner to agree the appropriateness and adequacy of the compensating controls. Examples include, but are not limited to, applying a model overlay to adjust the output, periodic materiality analysis to demonstrate the impact of the issue is understood and acceptable on an ongoing basis, or model monitoring to show the impact of the issue remains within acceptable limits. The key is that the action leads to a level of comfort on the usage of the model with known deficiencies. A plan to rebuild a model in the future is not a compensating control, but rather it is the root-cause remediation.

Issue Prioritization

Issue Severity and Model Materiality combine to produce an Issue Prioritization rating of High, Medium or Low.

Issue Prioritization	**Model Materiality**	
Issue Severity	**Material Models (4&3)**	**Less Material Models (2&1)**
Material Weakness	High	Medium
Identified Concern	Medium	Low
Immaterial	Low	Low

Remediation timeframes, extension approvals, and respective governance treatments are linked to Issue Prioritisation for all non-documentation MLC issues (e.g., (re)validation, implementation, use and monitoring).

These timeframes should be interpreted as the maximum allowable duration to remediate the issue. This includes any period for production implementation however this does not include the period where a model is pending regulatory approval if this stage is required for issue remediation.

In all instances of proposed remediation date extensions, GMV are to be engaged to review, challenge and endorse the associated rationale for extension and updated action plans along with timelines, prior to submitting for approval.

Timeframes, approvals, governance treatments	**Issue Priority**		
	High	**Medium**	**Low**
Maximum remediation duration	12 months	24 months	Next revalidation / redevelopment[34]
If proposed remediation date[35] is greater than the maximum remediation duration	MRC	Global Head of MRM	Global Head of GMV of the respective MF
Extension Approvals within maximum remediation duration	MRC	DMA[36]	GMV
Notification / Escalation	n/a	MAC/MRC	DMA
Risk Acceptance	n/a	Model Sponsor	Model Sponsor

[34] Whichever is the sooner. Note for models with an annual revalidation requirement, Low Priority Issues should be addressed within a maximum remediation timeframe of 24 months.

[35] Regardless of whether it is the original proposed remediation date, or an extension to the original remediation date.

[36] DMA to notify the next level of authority for approval for 2nd extension onwards i.e., if the DMA is an individual, they should notify (or escalate if required) the appropriate MAC, whereas if MAC is the DMA, they should notify (or escalate if required) to the MRC.

Notes:

- Issue Owner must ensure adequate compensating controls are in place to mitigate the model risk of High Priority Issue until the Issue is closed or reduced to below High. The Model Sponsor is ultimately accountable for adequate compensating controls.
- Risk Acceptance is only available for Low and Medium Priority issues which do not breach Regulatory requirements.

For documentation issues, the maximum allowable duration and specific actions are linked to Issue Severity (i.e., Model Materiality is not a factor). Extensions are not allowable for Documentation Issues.

Documentation Issues		
Issue Severity	**Timeframe for Remediation**	**Specific Action**
Material Weakness	Issue closure target date within maximum of 6 months.	Adopt latest TDD
Identified Concern	Issue closure target date within maximum of 6 months.	n/a
Immaterial	Issue closure target date aligned with next revalidation date or as part of model redevelopment if earlier.	n/a

Notes:

- For documentation issues, the maximum allowable time for remediation is 6 months for Material Weaknesses and Identified Concerns and the former requires redocumentation onto the latest TDD template.

Risk Acceptance of Issues

Risk acceptance is allowable for Medium and Low Priority Issues which do not breach any Regulatory requirements.

Risk Acceptance of Documentation Issues can only be considered in exceptional circumstances e.g., where an “in-use” model is planned to be decommissioned within 6 months or version replacement is due within 6 months, or an “in-flight” model is not planned to be put “in-use”.

As a first step the Model Sponsor should be engaged by the Model Owner to formally agree to the Risk Acceptance of the model issue. The Model Sponsor is the accountable executive for accepting the associated model risk on behalf of the business unit or function. Specific approval requirements for Risk Acceptance of Medium and Low Priority issues are as follows:

- Low Priority Issues which are Immaterial in Severity can be risk accepted by the Model Sponsor without an action plan in place. The Risk Acceptance must be presented to the DMA for noting.

- Low Priority Issues which are Identified Concern in Severity (i.e., on a Less Material model) must specify a process for periodic review to ensure they remain Low Priority. The action plan must specify the details of the periodic review including the frequency and actions to be taken in the event of an increase in the Issue Priority. The action plan must be approved by the DMA.

- Medium Priority Issues must specify a process for periodic review to ensure they remain Medium Priority. In addition, compensating controls and associated implementation timeframe must be agreed prior to approaching the DMA for approval of the action plan. GMV must be engaged to agree the appropriateness and adequacy of the compensating controls. The action plan must specify the details of the compensating controls, the periodic review including the frequency and actions to be taken in the event of an increase in the Issue Priority. The action plan must be approved by the DMA.

As part of the DMA approval of action plans (and notification of immaterial Low Priority Risk Acceptance), the DMA should have visibility of the level of concentration of Risk Acceptances within a given Model Family. Where this appears to be excessive the DMA may veto the Risk Acceptance.

Once the Model Sponsor has Risk Accepted and the DMA has approved the action plans, these are to be provided to the Model Validator who will update the issue status to Risk Accepted in GAME within two weeks.

Risk Accepted items must be re-affirmed by the Model Sponsor as part of the annual Model Sponsor attestation process.

17.2.2 Issues raised outside of the model life cycle

Model related issues may be raised outside of the MLC, for example by external audit, internal audit, or regulatory examiners. These types of issues are usually raised as part of findings from an audit or regulatory exam and are communicated in written format. The issue owner for a model specific issue is typically the Model Owner, however it could relate to other functions e.g., Process Owner for model monitoring, Process Owner for PMAs, Process Owner for model implementation. Similarly audit or regulatory issues could relate to second line activities e.g., GMV validation findings or MRPG governance findings.

GAME provides functionality for registration of information in relation to issues raised outside of the model life cycle. It is assumed that such issues have their own governance mechanisms in place e.g., internal audit issues registered and tracked in the audit system, or regulatory deliverables tracked via governance working groups with oversight from appropriate committees, and the intention is not to duplicate effort.

GAME can be utilized for recording of appropriate high-level information to ensure awareness of model related findings with reference to applicable governance processes in place. For example, where there is a detailed regulatory finding with many sub-deliverables tracked elsewhere, GAME can be used to record the overall delivery theme, due date, and governance mechanism in place, to allow for senior management reporting and awareness.

17.3 Documenting and Recording Issues

17.3.1 Issues raised as part of the model life cycle

Issues that are raised as part of the Model Validation / Revalidation process are documented as part of the Technical Validation Report (TVR).

Issues raised outside of the Model Validation / Revalidation process are documented on a standard stand-alone Model Issue template, maintained by Model Risk Policy and Governance (MRPG).

Documentation will capture:

- Model ID(s)
- Model Names(s)

- Issue Owner Name
- Individual Raising the Issue (MRM or Model Owner)
- Issue Title (single sentence describing the issue)
- Issue Description (description of the issue using language accessible to non-subject matter experts)
- Issue Risk Category (from taxonomy e.g., model specification, data, model output etc)
- Issue Severity Category (material weakness, identified concern, immaterial)
- Action Plan Details (description of the remediation to be carried out to address the issue)
- Solution Target Date (date for completion of the issue solution)
- Solution Review Date (date for completion of review of the solution by MRM)
- Regulatory Submission Date (for models requiring regulatory approval)
- Implementation Target Date (if relevant, date for completion of implementation in production)
- Issue Target Closure Date (date for overall issue remediation addressing the model risk)
- Model Sponsor Attestation (Only for risk-acceptance of identified concerns/immaterial severity)

All issues that remain open at the conclusion of the validation (or other MRM) process must be recorded in the Global Analytics Model Explorer (GAME) platform by the individual raising the issues (MRM or Model Owner) at the time of the completion of the validation (or other MRM) process. For example, open issues arising from a model validation are required to be entered into GAME with action plans on completion of the final TVR, prior to commencing the approval process. The issue start date should be set as that of the approval meeting.

All fields above will be captured, with the additional requirement of:

- Status (Open, Dev Analysis in Progress, Solution Review, Pending Regulatory Approval, Pending Implementation, In Review, Closed, Risk Accepted)

Here “In Review” refers to the state of an issue that has been submitted for final closure, but the internal assessment of closure is still being performed in accordance with section 17.4. Each recorded issue has a unique Issue ID which can be used for tracking and monitoring of issue closure.
The Issue Description must:

- describe the issue clearly and concisely.
- identify the source of the issue.
- briefly explain how the issue leads to model risk.

The Action Plan must:

- describe the action plan clearly and concisely.
- explain how the action plan either fully addresses the issue or provides an acceptable mitigant so as to partially address the issue,

OR

- in limited circumstances, where is the issue severity is “identified concern” or “immaterial” propose risk acceptance by the Model Sponsor (see below).

The issue owner must consult with MRM as part of the issue documentation process to ensure that the proposed action plan does address the issue to avoid issues remaining open on a perpetual basis.

Note:

- the target date refers to the date by which the action plan will be completed. If milestones are used to track intermediate actions, then the milestone dates must be documented as part of the action plan.
- where the action plan results in further model development work, the development plan must be entered in GAME to allow for planning of resources within development and validation.

Overarching Issues

Where deficiencies are highlighted with an underlying modelling infrastructure or framework, it is common for the same issue to repeat for all models that have the same framework dependency. In this instance remediation of the infrastructure issues will address the issue across all impacted models.

To avoid raising the same issue repeatedly a single instance of the framework issue will be opened with a unique ID. In practice, this means that the first time the issue is encountered as relates to a model, the issue will be opened in the usual manner – resulting in a new Issue ID. Where a second model is identified with the same issue, the issue will be documented in the usual manner, however when recording the issue in GAME the model ID will be linked to the existing Issue ID.

Note, this approach must only be followed where the remediation of the issue as detailed in the action plan will address the issue for the entire network of models impacted. Where it is the case that each individual model requires idiosyncratic remediation, an overarching issue must not be used, and separate issues must be raised for each model.

17.3.2 Issues raised outside of the model life cycle

Model related issues raised via external, internal, or regulatory audits, can be recorded in GAME with high-level information to allow for senior management reporting and awareness. The issue owner should record the following information in GAME:

- Model ID(s) to which the issue relates
- Model Names(s)
- Issue Owner Name
- Entity Raising the Issue (name of regulatory body or audit function)
- Issue Title (as specified by the entity raised the issue)
- Issue Description (high level text description of issue and where delivery is governed)
- Issue Severity Category (as specified by the entity raising the issue)
- Issue Closure Target Date (date for delivery of evidence demonstrating closure to entity raising the issue)
- Status (Open, In Review, Closed)

The issue owner should expect to be able to provide a RAG status on remediation delivery progress on request from senior management.

17.4 Monitoring and Closure of Issues

17.4.1 Issues raised as part of the model life cycle

Issue Tracking

Each issue has a unique GAME issue ID to allow for tracking progress against action plans to avoid them becoming overdue. The issue owner is responsible for tracking the end-to-end progress of the issue against the issue action plan with governance oversight provided by MRPG.

If an action plan is at risk of being delayed and/or a change is required to the action plan, the issue owner must review the issue and is responsible for ensuring a new target date and/or change in action plan is proposed, with a rationale for the delay. The proposal must be communicated to GMV in the first instance.

The outcome of a request for an extension could include, granting of the extension, revocation of the model approval status, escalation to a higher committee, or allowing the issue to go overdue. Where an extension is approved, the new issue closure target date, and/or action plan, must be recorded in GAME by the issue owner, together with the rationale for the re-targeting.

Low Priority Issues

Extensions to Low Priority Issues require approval from GMV (usually the Model Validator who raised the issue). Upon approval, the new issue closure target date, and/or action plan, must be recorded in GAME by the issue owner, together with the rationale for the re-targeting. The full audit trail of changes must also be maintained to present a clear view of issue remediation progress.

Medium Priority Issues

Extensions to Medium Priority Issues require approval from the original DMA, who may approve one target date extension. Subsequent extensions may be approved by the DMA, with notification to the next level authority[36] who may request further explanation from the issue owner and may choose to override the extension approval (for example where there has been no progress on issue remediation). If the proposed remediation date is greater than the maximum remediation duration[37], additional approval must also be obtained from Global Head, MRM (or delegate).

High Priority Issues

Extensions to High Priority Issues require approval from the MRC and must be supported by the Model Sponsor (or delegate).

Impact on Validation Outcome

When considering proposed extensions to issue target dates from the issue owner, GMV must assess the potential impact of extended remediation timelines on the prior Validation Outcome of the model (e.g., potential for moving from acceptable to conditionally acceptable). This includes documenting the rationale either as part of the extension approval (for identified concerns and immaterial weaknesses) or in support of the approval request (for material weaknesses) to the DMA. Where an extension to remediation timelines leads to a degradation of the Validation Outcome, the model will need to go for reapproval by the DMA.

MRPG provide oversight on progress against action plans, through oversight reports and / or Risk Information Reports (RIR). This should include key risk indicators (KRI) on the number and ageing of past due material issues per model family for consumption at oversight committees. The subset of

[37] Regardless of whether it is the original proposed remediation date, or an extension to the original remediation date

these KRI metrics relating to material models (with materiality = 3 or 4) should be presented to the GRC and MRC, as part of the CRO update report.

Issue Closure Process[38]

The first stage of closing an issue is the review of the completed issue solution. The issue owner must complete sections 1 and 2 of the standard issue closure template as maintained by MRPG on the Model Risk SharePoint Site page. This includes the original issue description, action plan and evidence of remediation provided by the solution. Once completed, the template, together with any required supporting evidence, should be sent to MRM (ideally the original Model Validator or member of MRPG who raised the issue, or if no longer present in SCB the relevant line manager) and notified to MRPG.

The issue owner should record the issue as "In Review" in GAME. MRM will assess the remediation rationale and evidence against the issue and document the assessment and outcome in sections 3 and 4 of the issue closure template.

There are three possible outcomes:

- Fully addressed
- Partially addressed
- Not addressed

The relevant MRM line manager is required to sign-off on the issue closure outcome.

Fully addressed – where the solution provides a full remediation of the issue and there are no outstanding regulatory approval requirements or implementation requirements, MRM will proceed to close the issue.

Where there are additional requirements for regulatory approval the issue should be marked as "pending regulatory approval". Once regulatory approval is obtained the issue status should be updated to either "closed" (if no implementation is outstanding) or "pending implementation" if still outstanding.

Where there are only additional implementation requirements outstanding, the issue should be marked as "pending implementation". On completion of a successful implementation (as evidenced by the User Acceptance Testing signoff (c.f. Section 10), the ICP should be updated by the Issue Owner and re-submitted to MRM for closure.

Partially addressed – where the solution provides a partial remediation of an issue this will result in a residual portion of the original issue remaining, and the description of the residual issue and severity may therefore change, as will the required action plan and target date. For the issue to be considered as partially remediated there must be no outstanding regulatory approval or implementation requirements in the part of the solution that provides partial remediation. MRM and the issue owner will discuss the residual issue and appropriate severity level. MRM will record the residual issue description together with any reduction in severity, along with the revised action plan and new issue target date, as provided by the issue owner, in section 5 of the template.

Not-addressed – where an issue has not been addressed by the evidence provided, the issue owner is responsible for providing a revised action plan and issue target date to MRM for inclusion in section 5 of the template. The original issue description and severity will remain.

[38] The issue closure process does not apply to Policy Compliance Assessment Template ("PCAT") related issues.

MRM is responsible for uploading the issue closure template to GAME, and for making any relevant changes to the issue as recorded in GAME (e.g., closure of issue, change in issue description, change in action plan, change in issue closure target date, and issue review date).

On occasion it may be more practical to close the original issue and open a new issue with the residual remaining risks, with a new action plan associated with it.

Where closed model issues result in an improvement of the Validation Outcome to an approved model (e.g., a reduction from unacceptable to either conditionally acceptable or acceptable), the Model Validator must provide a rationale for the improvement of the Validation Outcome in the issue closure template. The Model Validator is responsible for ensuring that the TVR and GAME are updated to reflect the change in Validation Outcome. Since the model was already approved for use under a worse Validation Outcome, there is no requirement to seek further approval, however the change in status must be notified to MRPG and the relevant DMA.

Note: careful consideration must be given to the data used within the model closure process e.g., UK GDPR and DPA 2018. The issue owner and MRM are responsible for ensuring that no sensitive data is contained in their respective sections of the issue closure template or in supporting evidence, and that suitable masking or anonymization is applied.

17.4.2 Issues raised outside of the model life cycle

Issue Tracking

Issues raised outside of the model life cycle are expected to have their own governance mechanisms in place to ensure delivery. Where delays in remediation are expected, the issue owner should communicate this to the appropriate oversight committees (e.g., TMAC/CMAC/FCCMAC/MRC) to ensure full transparency. GAME provides a mechanism for registering high-level information for such issues to allow for a consolidated register of in-flight deliveries.

Issue Closure

Issues raised outside of the MLC can only be closed by the entity who raised the issue (e.g., external audit, internal audit, or regulatory body).

The issue owner should follow the appropriate process for submitting the evidence of closure (e.g., compliance related requirements when submitting regulatory issues, or internal audit related requirements for issue closure packs).

Following submission, the issue owner should update the record in GAME as “In Review”, until communication is received confirming closure at which point it will be marked as “Closed”. In the event the issue closure is not agreed, the issue owner is responsible for updating the record in GAME to “Open” and the issue description with revised target dates to reflect feedback received.

18. ADDITIONAL CONSIDERATIONS FOR AI/ML PROCESSING COMPONENTS

18.1 Introduction

Overview

Artificial Intelligence (‘AI’) refers to solutions or systems that act in the physical or digital world by perceiving their environment, collecting structured or unstructured data, interpreting the collected data, reasoning on the knowledge derived from this data and deciding the best action(s) to take to achieve a given objective.

Machine Learning ('ML') is a subdivision of the broader AI classification, focusing on algorithms that can learn patterns from raw data. Example of ML algorithms range from the traditional (e.g., linear and logistic regression, decisions trees) through to more complicated and recent approaches (e.g., support vector machines, random forests, gradient boosted machines, clustering techniques, reinforcement learning and neural networks). ML also comes in various sizes and shapes, for example,

- Supervised Learning algorithms construct models for predicting outcomes based on past observations and trained based on historical input-output data.
- Unsupervised Learning algorithms, where the algorithm finds patterns based solely on input data i.e., no historical input-output training.
- Reinforcement Learning algorithms, which are goal-oriented to obtain a complex objective, often starting from a blank state.

In this section we use the term AI throughout, to refer to both AI and ML algorithms (as a subset of AI).

Model Risk Management of AI processing

As detailed in Section 3, a model is comprised of an input component, a processing component, and an output component. AI algorithms are a particular type of processing component, as used within a given AI system. The model universe within SCB Group is captured via a list of model families, representing different use-cases. As such the presence of AI processing does not give rise to new model types but should be treated as a particular type of processing within the applicable model family.

Note, all AI systems – both those classified as models (i.e., in GMRP recognized model families) and those not classified as models, are still required to follow the *Group Responsible AI Standards*, which defines a generic governance framework for all AI systems. Those meeting the criteria to be classified as a model are also subject to requirements in GMRP and Group Standards.

The Model Risk Management framework, depicted through Sections 1 to 17, is agnostic to the type of model being considered, and applies equally well to models with AI processing components. However, the use of AI as a processing component does present AI specific risks which need further consideration within the existing framework. These AI specific risks also exist for some models without AI processing, but the presence of AI has the propensity to amplify the risks more than a model with traditional processing.

These AI specific risks are detailed in the following sections together with additional development and validation requirements.

18.2 AI Specific Risks

In this section we outline certain risks that may be amplified when an AI algorithm is used as a processing component. Following the standard model definition, we adopt a linear narrative starting with input considerations, through to processing and finally output.

18.2.1 Big Data

AI systems are typically heavily reliant on significant amounts of data, leading to heightened exposure to data related issues and the following points must be considered when developing and validating models with AI processing.

- Data quality – data must be of sufficient quality to enable meaningful model predictions and structured in a machine understandable format for consumption by the algorithm. Poor quality, inaccurate or incomplete data used by a model can give rise to inaccurate model predictions.

- Data integrity – data sources must be reliable (credible), available now and in the foreseeable future. Data must be appropriate for the given use-case. Where multiple data sources are combined, consistency must be considered when assessing overall data integrity.
- Data privacy – careful consideration must be given to the data used within a model[39], particularly in relation to sensitive data and applicable regulation e.g., UK GDPR and DPA 2018.
- Data security – data sources must be securely maintained to avoid data leakage and/or manipulation.
- Data bias – data used for training the model must be consistent with the intended use-case of the model to avoid introducing bias. The continued introduction of extraneous data must be appropriately controlled to avoid future instances of bias occurrence. For specific consideration on bias, see section 18.2.4 below.

Development Requirements

The Model Owner, together with any dedicated Process Owners for Data, are responsible for ensuring a suitable data governance framework ("DGF") is established to ensure data quality and security. A typical governance framework must consider the following points:

- Objective – there must be a clear definition of the objective of the data governance framework, referring to existing policies and procedures and extending as appropriate. Roles and responsibilities must be clearly defined.
- Data risk mitigation – processes for detecting and mitigating irregularities and biases in data must be documented. Where there is a dependency on third-party AI systems or data there must be well defined procedures for liaising with the vendor to detect and remediate data quality issues. Where there is usage of third-party information from internet or media, controls on data misuse must be implemented.
- Data ethics, privacy, and security – different layers of security should be established across different privacy levels based on confidentiality and materiality. The collection and use of customer data must be ethical i.e., compliant with applicable laws and any data sharing with third parties in line with company policies.
- Data warehousing – data should be stored in a centralised database to store and retrieve data efficiently including the maintenance of a comprehensive record of meta data. (e.g., data definition, source, and usage).

Where AI processing is used within a given model family, the applicable Model Family Standards must specify the DGF for the models in scope. This includes roles and responsibilities within the framework, with reference to relevant internal policies and procedures, and must consider all points listed above.

Data quality and integrity requirements in relation to model development activities are defined in Section 7 of Group Standards. The presence of AI amplifies the importance of data quality and integrity and introduces additional criteria for consideration in the form of data ethics, privacy and security and data warehousing infrastructure, that must be taken into consideration.

The Model Owner, with input from relevant Data Process Owners, is responsible for the specification of requirements for the DGF in the applicable Model Family Standards. These should be reflected in the TDD sufficiently to support a model submission.

[39] In accordance with RAI Standards, the Group declares the following variables as "protected" due to their ability to introduce bias to groups of people: gender, ethnicity, nationality, sexual orientation, and religion. These, or proxies to these, must not be used in AI algorithms.

Independent Validation Requirements

In accordance with Section 8 of Group Standards, data integrity, data quality review and challenge, is performed for all model submissions. Where there is an AI processing component, the review and challenge must take into consideration the heightened dependency on data quality and integrity, as well as the additional data related criteria such as, data ethics, privacy and security and the structural form of the data warehousing. The overall DGF must be assessed for any weaknesses which could lead to heightened model uncertainty and must be documented as part of the data assessment in the applicable TVR.

The existing model uncertainty rating guidance for Model Input Data is extended to take into consideration the DGF requirements for AI processing as part of the slotting criteria as follows.

Uncertainty Rating Assignment Guidance	
Model Input Data (additional slotting criteria for AI processing)	
Guidance	When assessing the uncertainty rating for the DGF one must consider; the heightened dependency on data quality and integrity, the degree of confidential and sensitive data used, data ethics relating to the use of personal information taking into consideration any applicable laws and regulations, and the effectiveness of proposed data security measures
A	• Data Governance Framework established and effective
B	• Data Governance Framework established with observed minor gaps
C	• Data Governance Framework established but with observed major gaps
D	• No Data Governance Framework established

18.2.2 Complexity & Conceptual Soundness

Complexity as a risk driver within model risk is nothing new. However, the introduction of AI related models has the potential to amplify this risk even more, primarily due to the lack of transparency and potential lack of a causal relationship. In addition, the AI landscape is rapidly evolving with new techniques emerging on a frequency basis, making it challenging to keep up with the technological progress.

Some third-party products allow for automated training of models, or pre-trained models, which could lead to lack of transparency of associated model risks and the ability to assess conceptual soundness. There is also the potential for over-fitting, where a model is over-trained on historical input-output data, limiting its ability to predict outside of the training data set.

One focus of a robust Model Risk Management framework is to ensure the conceptual soundness of models for a given use case. Traditional models are based on well-defined causal relationships (cause-effect) e.g., valuation pricing models. AI models learn relationships from exposure to data, which may change over time leading to a change in their inner logic, making it harder to assess conceptual soundness.

Development Requirements

The Model Owner is responsible for ensuring the existence of suitably qualified individuals to ensure there is sufficient understanding of AI models within their ownership scope and the associated risks posed by those models.

Given the increased complexity, careful consideration must be exercised by the Model Sponsor and Model Owner when proposing models using AI processing for decision making purposes, including but not limited to:

- Advantages and disadvantages of adopting AI processing versus more traditional modelling.
- Any elevated areas of risk if AI processing is adopted.
- In house understanding of the AI model including advantages and disadvantages.
- Previous experience with proposed technology solution.
- Any supporting industry or academic experience with the proposed AI system.
- Amount of control over the model e.g., internal build or vendor solution, selection of training. data (potential for over-fitting), transparency of algorithms etc.
- Senior management awareness of risks and understanding of the Model Owner assessment of those risks.

The Model Owner is responsible for ensuring the assessment requirements and the process for adoption of AI models is specified in the applicable Model Family Standards take into consideration the points raised above.

As part of the development process, the Model Owner is responsible for ensuring that the choice of an AI solution for a given business problem is sufficiently justified in the TDD as part of the model selection process. For AI models this must include documented rationale of the advantages and disadvantages of AI adoption when compared against more traditional approaches.

Independent Validation Requirements
In accordance with Section 8 of Group Standards, model validation will independently review and challenge the model selection criteria as detailed in the TDD model submission. For AI related models this must include an assessment of the support provided for the adoption of AI versus the use of a more traditional model where the assessment of conceptual soundness may be more transparent.

Complexity in modelling is already captured as slotting criteria within the existing uncertainty rating guidance, within the Model Specification risk driver and no further extension to AI is required.

18.2.3 Explainability and Interpretability

Explainability or interpretability relates to the ability to understand the reasons for an AI decision and hence provide a degree of transparency in the rationale for the model output. Traditional models typically rely on hard-coded mathematical relationships or on explainable linear statistical relationships. On the other hand, AI systems usually rely on learnt, non-linear statistical relationships, where the parameter/variable dimensionality is extremely high. As such there is no clear visibility on the internal mechanics of an AI model leading to a “black box” type of modelling approach.

Given requirements on establishing conceptual soundness of a modelling approach, demonstrating some form of interpretability is vital for AI related models. This is important for both the first line, as part of the development process, enabling Model Users to gain comfort, and for the second line as part of the challenge process relating to the model output.

While the term AI, may be applied equally to linear (e.g., decision trees, logistic regression) and non-linear algorithms (e.g., random forests, gradient boosting techniques), explainability is not usually a problem for the former. Linear algorithms are usually explainable by design, are quite straightforward and very well understood as part of the existing Model Risk Management framework. Therefore, the focus is primarily on non-linear algorithms in terms of interpretability requirements due to the black-box nature of the models.

Development Requirements

As part of the development process the Model Owner is responsible for assessing the relative trade-off in relation to the desired level of interpretability in the model versus potential for reduced performance. The Model Owner is responsible for ensuring that interpretability of the model is considered by the Model Developer including the use of appropriate explanation techniques as part of the model development process. The use of more explanation technique is usually preferable in most cases. The level of investigation performed in relation to model explain should be aligned with the perceived level of model risk as captured by the MRR.

A common approach to explainability is to take a model that is trained and then assess the model output using a controlled variation of the inputs. The use of such sensitivity or scenario analysis for assessing black-box model behaviour is not a new thing, e.g., assessing vendor model performance where the internal workings of a model are proprietary. Examples of specific techniques adopted within the AI space include local surrogate models (LIME), Shapley values (SHAP), deriving rules (Anchors) and individual conditional expectation (ICE). This list is not exhaustive and there are many approaches available to provide insight on the AI model decision process e.g., training a linear global surrogate model to perform the same task as the non-linear model, and deriving a causal understanding based on the linear system.

The Model Owner and Model Sponsor are responsible for establishing a suitable control process involving independent subject matter experts (typically Model Users) to periodically assess the model output and ensure that model-based decisions are still relevant and accurate for each use-case. The frequency of the assessment should be aligned with the perceived level of model risk as captured by the MRR.

The TDD model submission must include the explanation techniques considered within the development process with a rationale for the choice of techniques, and the control process relating to the model output (e.g. frequency of assessment, potential outcomes of assessment). Where the same type of technique and/or control is applied consistently across models in a model family, the Model Owner is responsible for ensuring this is embedded in the applicable Model Family Standards.

Independent Validation Requirements

As part of the independent validation, the Model Validator must review and challenge the perceived level of model interpretability and assess whether the explanation techniques adopted in the TDD have provided a sufficient level of explainability of the model output, taking into consideration the MRR of the model. The Model Validator must assess whether it is possible to perform additional independent analysis to further enhance the explainability of the model, perhaps using different explanation techniques to those adopted in the TDD. Where possible, the Model Validator should assess the effectiveness of the model output control process, taking into consideration the MRR.

Model interpretability / explainability is primarily concerned with obtaining an understanding of what a black-box model is doing i.e., an attempt to understand the reasonableness of the model without having access to the underlying mechanics. The existing model uncertainty rating guidance for Model Specification is extended to take into consideration the opaque nature of the model workings with explanation techniques providing a form of mitigation as follows.

Uncertainty Rating Assignment Guidance	
Model Specification (additional slotting criteria for AI processing)	
Guidance	When assessing the transparency of the decision process in the AI model one must consider the level of understanding in relation to the decision process before and after the application of explanation techniques. The application of good explanation techniques acts as a mitigant to the lack of transparency in the model workings.
A	• Full transparency of decision process possibly with explanation techniques
B	• Opaque decision process with good set of plausible explanation techniques provided
C	• Opaque decision process with limited set of plausible explanation techniques provided
D	• No transparency of decision process with no plausible explanation techniques provided

18.2.4 Bias and Fairness

The potential for bias in modelling is not specific to AI processing, for example a simple regression model could exhibit bias if the data used to fit the model was skewed in a certain dimension, or certain fitting characteristics omitted. However, with the heightened dependency of AI processing on data, there is the potential for AI to amplify the bias risk. Although linked to data used to train a model, this risk is sufficiently well-known that it deserves to be considered in isolation.

While definitions of bias vary, we may think of this as; *generating decisions that treat distinct groups of entities differently without an objective reason or making decisions based on inputs which cannot be reasonably expected to matter in that particular case.*

There is no universal definition of fairness, which has multiple dimensions that are often in direct competition with each other (e.g., fairness to the group versus fairness to the individual), requiring an informed trade-off as part of the model design process.

Bias and fairness are not applicable to all AI systems and need to be considered on a case-by-case basis. For example, where the decision process is likely to impact individuals or groups (e.g., as part of a credit rating process), both fairness and bias would be relevant.

Data Bias

Data bias in AI typically arises in two ways:

- Selection bias – this bias occurs when data used to produce the model is not fully representative of the actual data or environment the model will function in. For example, omission bias where certain demographics or features are omitted from the training data, or stereotype bias where only a subset of data is used to derive behaviour of a larger set of data.
- Measurement bias – this bias occurs when the data collection mechanism skews the data in a particular direction.

Development Requirements

As part of the development process the Model Owner is responsible for ensuring a bias and fairness review (BFR) is conducted for each model using an AI processing component, to assess the importance of both aspects. The BFR must address the following points:

- Does the model output have a non-negligible impact on the life of individuals?
- Does the model limit individual's free choice?
- Does the model limit the human rights of individuals?

- Are there any indicators to suggest the model output contravenes known regulations or laws in relation to bias and fairness?
- Is the model applied where there is a perceived asymmetry of power between the Group and the groups and individuals impacted by the AI decision?
- Is the model operating in an area where historically there has been bias and fairness issues?
- Does the model use any 'protected variable' (i.e., variables that are prohibited or regulated by law or of a sensitive nature)?
- Downstream usage of the model.
- Any other SCB specific considerations that would make bias and fairness relevant.

To make an informed decision on the questions above, it may prove necessary for the Model Owner and Model Developer to engage with suitably qualified individuals (e.g., legal, compliance) for more information.

The output of the BFR should determine the importance of the bias and fairness in the context of the model being developed. Where the conclusion is that bias and/or fairness are relevant, the Model Owner is responsible for:

- Ensuring there is suitable handling of protected or sensitive variables including:
    - Ensuring compliance with relevant laws and regulation (removing prohibited variables).
    - Justification for use of allowed but sensitive variables, considering the potential reputational and other risks of inclusion.
    - Ensuring accuracy of data.
    - Appropriate level of security.
- Addressing any known or potential model bias in relation to the input data to be applied to the model. For example:
    - Defining attributes against which bias, and fairness will be measured (e.g., age, gender).
    - Identification of variables likely to generate bias.
    - Assessing the impact of these variables on the decision-making process.
    - Where there is significant impact, justification for continued inclusion or variable removal.
    - Assessing the impact of variable removal (e.g., has the bias been mitigated?)
    - Applying other compensatory adjustments to the model to remove the bias.
    - Defining ongoing monitoring requirements for the detection of model bias.

Note when considering how to remove bias there is a potential conflict with fairness considerations, e.g., if removal of a variable from the model resulted in increased cost for everyone, resulting in exclusion of some individuals from accessing products. Similarly removing statistically significant variables could lead to deterioration in model accuracy.

The Model Owner is responsible for ensuring that a suitable BFR is documented in the applicable Model Family Standards, together with the process to be followed where bias and fairness is deemed to be relevant to the models within scope, addressing the criteria above. Where the approach for removal of bias is generic, this must be documented as part of the applicable Model Family Standards. The development documentation as captured in the TDD, must reflect the outcome of the

BFR, with supporting rationale and describe the process for addressing the bias concerns in data, as well as the ongoing monitoring requirements to detect further instances.

Independent Validation Requirements

As part of the independent validation, the Model Validator will review and challenge the BFR as detailed in the TDD model submission. This must include an assessment of the criteria considered to derive conclusion. Where bias is detected as part of the BFR, the validator must review and challenge the handling of any protected or sensitive variables as part of the DGF, and the proposed handling of the model bias both as part of the development process and on an ongoing basis via model monitoring. The assessment will be documented in the applicable TVR.

Deficiencies in the handling of sensitive, protected, or restricted information has already been addressed in section 18.2.1 in terms of a data governance framework, and issues raised are captured by the prior section.

The presence of bias is detectable as a deficiency in the model output, in terms of observed model performance. As a result, the existing model uncertainty rating guidance for Model Performance is extended to take into consideration the assessment of bias arising from AI biased model performance as follows.

Uncertainty Rating Assignment Guidance	
Model Performance (additional slotting criteria for AI processing)	
Guidance	When assessing the performance uncertainty rating for bias in an AI process, one must consider the impact on the decision process of the observed bias, and any compensating controls in place to mitigate the bias. In addition, the effectiveness of the proposed model monitoring to detect bias must be considered.
A	• No observed bias in the model decision process • Effective bias monitoring on an ongoing basis
B	• Observed bias in the model decision but with negligible impact • Deficiencies in bias monitoring where it is believed the bias impact will be negligible
C	• Observed bias in model decision with observable but not severe impact • Deficiencies in bias monitoring where it could lead to an observable (not severe) bias impact
D	• Observed bias in model decision process with severe impact • Deficiencies in bias monitoring where it is believed the bias impact could be severe

18.2.5 Third-party model dependency

The use of third-party systems or models has been increasingly prevalent with regards to AI adoption in many banks, partly driven by the rapidly evolving nature of the industry and relatively recent ‘data scientist’ skill sets required to build such models. There is also an increased use of pre-trained models, straight out of the box, which brings potential model risks in relation to suitability of training data for the intended model use-cases, which could lead to over-fitting, and may limit the ability to track and control model bias.

Due to the lack of transparency, in both model design and data considerations, associated with proprietary third-party models, the existence of good model documentation, including detailed explanation testing, is of heightened importance.

As per Section 4.1, for each vendor model the Model Sponsor is responsible for the appointment of an internal Model Owner. Given the potential for a heightened lack of transparency relating to the modelling details in a proprietary AI model, it is very important for the Model Sponsor to ensure that appropriate service level agreements (SLA) are in place reflecting the model risk management requirements detailed in Section 6.3.

Development Requirements

As detailed in Section 7.2.13 the expectations relating to model development for models designed and trained by third parties are the same as for internal models. Given heightened risks in relation to AI modelling details the Model Owner is responsible for ensuring that there is a first-line model risk process for the critical evaluation of vendor documentation. This must include a critical review of the interpretability outcome explanations, training data as relates to the proposed use-case of the model, and the identification and mitigation of bias in line with BFR requirements in the applicable Model Family Standards. The Model Owner should work with the Model Sponsor to ensure the necessary requirements are embedded in the relevant vendor SLA, to ensure that conceptual soundness of the model can be supported initially and on an ongoing basis.

Independent Validation Requirements

As detailed in Section 8.3.1 the expectations relating to model validation for models designed and trained by third parties are the same as for internal models. The additional AI considerations in relation to model explainability, suitability of training data for intended use cases, and bias handling, must be critically reviewed by the validator.

The risk from adopting a vendor solution is already captured as slotting criteria within the existing uncertainty rating guidance, within the Implementation and Operating Environment risk driver and no further extension to AI is required.

18.2.6 AI Model Reliance

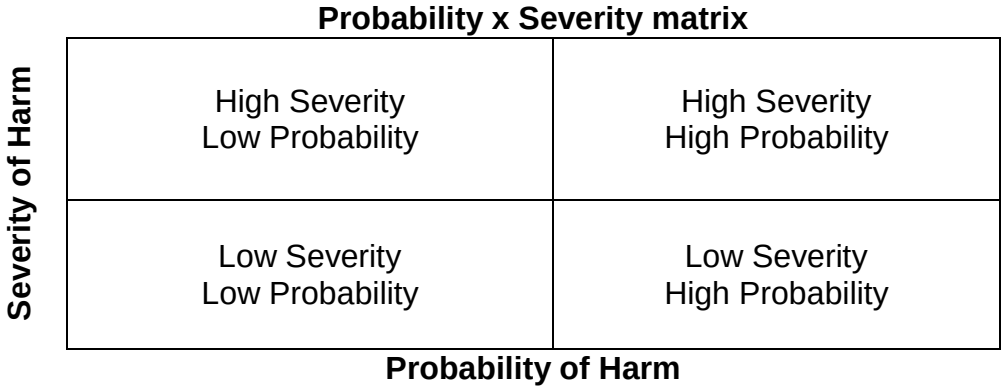
When considering an AI model, it is important to assess the level of human involvement in the process i.e., whether the output of the model is used directly in a decision process or if there is an additional layer of human oversight provided. In general, there are three types of human involvement possible:

- Human “out of the loop”: AI system in full control with no human oversight
- Human “over (or on) the loop”: human oversight / monitoring to address undesirable outcomes
- Human “in the loop”: human oversight is active and involved, with humans retaining full control and AI making recommendations upon which the decision is based

Here “out of the loop” exhibits the highest level of model reliance and “in the loop” exhibits the lowest level of model reliance.

Development Requirements

When developing or onboarding an AI model, the Model Owner must assess the need for human involvement in the decision process. As part of this assessment the Model Owner must consider the probability of a negative (harming) event occurring and the severity of the event on SCB Group. This is easily depicted in a Probability x Severity matrix, as shown below.



The type of harm will be dependent on the use case of the model but could include reputational as well as financial losses. For a (high-severity, high-probability) assessment, a human "in the loop" model might be prudent. For a (low-severity, low-probability) assessment it might be possible to adopt a human "out of the loop" model.

The level of human involvement will impact the reliance on the AI model. In accordance with section 16.2, the Materiality Rating assigned to the model must also include a consideration of the reliance on the model.

Independent Validation Requirements

As part of the independent validation, the Model Validator will review and challenge the reliance on the model, taking into consideration the probability and severity of a negative outcome and the appropriateness of the assigned materiality rating.

18.3 Model Risk Management Governance of AI

18.3.1 Internal Governance Requirements

All AI systems (both models and non-models) are required to follow the *Group Responsible AI Standards* which defines a generic governance framework for all AI systems.

For those AI systems which also qualify as a model, the standard governance requirements applicable to all models apply. This includes:

- Inventory of AI models as part of the model use case in the applicable model family
- Determining the MRR based on the model materiality rating and uncertainty rating, including the additional slotting criteria covered in Sections 18.2.
- Following applicable stages of the MLC requirements (see section 18.3.2).
- Defining model monitoring requirements as part of the applicable Model Family Standards, taking into consideration the need to track; model accuracy, bias and explainability, possibly on a more frequent basis than would be required for traditional models.
- Defining model change process as part of the applicable Model Family Standards, considering the need to re-train AI algorithms and/or change models based on findings from the model monitoring.

- Extension of Model Family Standards to include AI-ML specific considerations covered in Section 18 of the Group Standards for any models using AI processing within scope of the applicable standards.

18.3.2 Governance vs Validation

There may be occasions where blindly applying requirements to perform a validation is non-beneficial. For example, a point in time validation of a "black box" Large Language Model ("LLM"), with large parameter space would only give limited comfort and assurance for a given use-case. Similar considerations would also apply to facial recognition technologies – another example of black-box type of model, where the parameter space in terms of pixel recognition is extremely large. In both cases the validation activities that can be performed would be extremely limited and only provide limited model risk mitigation.

The priority in such cases should be the ongoing governance and management controls (e.g., reliance on model monitoring and oversight) that can be applied to the model output to mitigate potential risks rather than applying a validation as part of a regimented framework requirement which would only give limited assurance on any modelling limitations.

When reviewing such models, an assessment should be performed on which aspects of the MLC will mitigate the model risks, rather than following a cookbook approach of performing a validation that will only be of limited value. Where there is limited gain from performing such validation activities the decision to rely on other aspects of the MLC (e.g., ongoing monitoring and review of performance) should be approved by the Global Head Model Risk Management, with rationale presented for consideration as part of the approval request. Given the rapidly evolving paradigm of AI/ML usage such decisions should be revisited on a periodic basis to re-assess whether technology has evolved to an extent that a meaningful validation can be performed.

18.3.3 External Governance Requirements

In this section we recap recent external publications relating to governance requirements that should be considered as best practice when using AI applications. These publications have provided the basis for the identification of additional AI specific risk risks in section 18.2.

In November 2018 the Monetary Authority of Singapore (MAS) issued *Principles to Promote Fairness, Ethics, Accountability and Transparency (FEAT) in the use of Artificial Intelligence and Data Analytics in Singapore's Financial Sector*. This was subsequently extended by De Nederlandsche Bank (DNB) in July 2019, in the form of *General Principles for the use of Artificial Intelligence in the Financial Sector*, encapsulating two additional principles, Soundness and Skills, with the acronym SAFEST.

In October 2019 the Bank of England (BoE) published *Machine Learning in UK Financial Services*. In 2019 the Hong Kong Monetary Authority (HKMA) published three guidelines; (a) *High-level principles on artificial intelligence* (November), (b) *Consumer protection in respect of Use of Big Data Analytics and Artificial Intelligence by Authorized Institutions* (November), and (c) *Reshaping banking with artificial intelligence* (December).

In January 2020 Singapore's Info-communications Media Development Authority (IMDA) and Personal Data Protection Commission (PDPC), partnered together to publish a *Model Artificial Intelligence Governance Framework*. Later in 2020 the Hong Kong Institute for Monetary and Financial Research (HKIMR) published a report, *Artificial Intelligence in Banking – The Changing landscape in compliance and supervision*, focusing on governance and oversight of the use of artificial intelligence in banking.

The above list of publications is not intended to be exhaustive, however materials referenced provide good insight to the expectations relating to governance of AI algorithms, as perhaps best encapsulated by the DNB SAFEST principles, which should be taken into consideration when developing, validating, and using AI applications.

- **S**oundness
  - Ensure general compliance with regulatory obligations for AI applications.
  - Mitigate financial (and other) risks in the development and use of AI applications.
  - Focus on mitigation of model risk for material AI applications.
  - Safeguard and improve the quality of data used by AI applications.
  - Ensure appropriate control of third-party AI applications.
- **A**ccountability
  - Assign accountability for AI applications and the management of risks.
  - Ensure Board awareness of AI related risks.
  - Ensure internal accountability for third-party AI applications.
- **F**airness
  - Define and operationalise the concept of fairness for AI applications.
  - Review the outcome of AI applications for unintentional bias.
- **E**thics
  - Specify an ethical code aligned with internal ethical standards.
  - Ensure that outcomes from AI applications do not violate these ethical standards.
- **S**kills
  - Ensure that senior management has a suitable understanding of AI.
  - Train risk management and compliance personnel in AI.
  - Develop awareness and understanding of AI within the organisation.
- **T**ransparency
  - Ensure transparency about policy and decisions regarding the adoption and use of AI.
  - Develop tools and interfaces that facilitate explainability and traceability of AI usage.

19. COUNTRY MODEL RISK GOVERNANCE GUIDELINES

19.1 Introduction

Overview

The Model RTF is cascaded to countries that have adopted it by way of local addendum or local framework documentation, herein referred to as 'in-scope' countries.

For countries that have formally adopted the Model RTF, Policy [GMRP 2.16] specifies responsibilities of the Country Model RFO[40] or delegate[41] as 2LoD, and the requirements must be adhered to within 6

[40] As per the Model RTF, the Country Model RFO is typically the Country CRO.

[41] Individuals acting on behalf of Country Model RFO, typically the Country risk Governance teams/ Country model risk governance individuals.

months of country adoption of the Model RTF. The main responsibilities of Country Model RFO is to ensure:

- Model Usage is correctly identified within the country, captured in the Country Model Inventory and attested to on a semi-annual basis.
- A suitable local governance process is established to accommodate models requiring local regulatory approval, to provide model risk oversight and for any other specific local regulatory requirements at the country or legal entity level.
- Ensure fundamental model risk training is provided for respective country stakeholders.

Given the differing levels of regulatory requirements and scrutiny across in-scope countries relating to Model Risk, a tiering approach is adopted to provide appropriate risk-based levels of depth and rigor of the associated requirements. The below outlines the criteria to be applied to determine the most appropriate tier for each in-scope country and the high-level requirements.

- Tier 1 – Countries with regulatory capital requirements with IMM, IRB or IMA permission for use of models for regulatory capital calculation. The Country RFO must ensure all specific requirements, as stipulated by respective regulations, are adhered to through local processes, including local model approvals, where required, as not to put the existing permissions at risk.
- Tier 2 – Countries where regulators have clear expectations regarding Model Risk but do not have permissions for use of models for regulatory capital calculations. For example, these countries may have a specific regulatory standard or articulated expectation, which may be limited to specific model families. The Country RFO must understand the regulatory requirements and ensure suitable processes are embedded to meet the regulatory expectation.
- Tier 3 – Remainder of in-scope countries (i.e., excluding Tier 1 and Tier 2) where there are no strict regulatory requirements for model risk. Such countries must follow the minimum requirements as provided by these standards with no additional requirements.

Country Model RFO is to determine the most appropriate tier and ensure the respective requirements are adhered to.

The minimum requirements for all tiers are:

(i) Maintain an accurate country model inventory.
(ii) Provide periodic Model Risk Reporting to relevant governance forums, and other key parties upon request e.g., Regulators, GIA, External Audit, etc.
(iii) Ensure fundamental model risk training is provided for respective country stakeholders.

Tier 2 countries must meet the minimum requirements with the following additions:

- Perform a gap assessment with local regulations and the Group MRM framework and update the local addendum where required. Coordinate with MRPG for any proposed expansion to the Group MRM framework.
- Ensure periodic training for respective stakeholders as prescribed by local regulators, where required and in compliance with country practices.
- Monitor any additional certification requirements mandated by the local regulator and ensure that necessary certifications are undertaken by the relevant staff.
- Where local model suitability tests are required as per local regulations, an assessment of technical competence and staffing requirements should be assessed by country.
- Establish a process for country model users, report locally applied PMAs in GAME, ensure sufficient governance is followed in line with respective model family standards.
- Any of the Tier 1 or other requirements stipulated by respective local regulator(s) or deemed necessary by the Country RFO.

Tier 1 countries must meet the minimum requirements, as well as the requirements of Tier 2 and the following:

- Monitoring and reporting of Risk Appetite metrics to relevant governance forums.
- Ensure any local model approval requirements are adequately governed and recorded in GAME.
- Ensure staff using or testing IRB, IMM, IMA models used for capital requirements are technically competent and are nominated for the advanced e-learning modules.
- Establish local model materiality, where required i.e., Group Materiality is deemed inadequate, to ensure the intensity and frequency of validation is appropriate.
- Where Group models are used in Country, verify the relevance of the data and assumptions for the intended use in Country.
- Verify local process owners/ business managers and country specific model risk roles to ascertain they are meeting responsibilities [GMRP 1.3].
- Maintain oversight on drivers of model risk and respective remediation, including reviewing model monitoring results, to sufficiently fulfil regulatory expectations and reporting expectations to senior committee on a periodic basis.

Countries that are not in-scope of the Model RTF, can request to be brought in scope if determined necessary by the CCRO, e.g., due to increased local regulatory or senior management expectations.

Where countries that are not in-scope have an obligation to report the model inventory to a regulator with no additional requirements, the country can centrally record these models in GAME by coordinating with MRPG and the GAME team. However, the accountability for the veracity of the information in GAME remains with Country CRO (or delegate).

The following section provides more detailed guidelines for the Country Model RFO.

19.2 Country Model Risk Governance Guidance

Local regulatory requirements and expectation are generally higher for those countries that have local regulatory approval requirements (e.g., Group subsidiaries with locally approved regulatory capital models – Tier 1), or other specific regulatory focus (Tier 2). The following should be treated as guidance to maintain effective model risk management within country and should be interpreted accordingly.

Where blockers are identified, such as clarity on GMRP / GMRS, influencing the remediation of RA breaches, interpretation of local regulations impacting model risk, etc., this should be notified to Group MRPG function.

Local Governance and Oversight:

- Act as a country level single point of contact for model risk related matters and maintain oversight on model risk view in country. Be aware of the level of model risk the country is exposed to, including the main drivers, remediations and current mitigants.
- Identify responsible individuals in country for determining model usage and document the responsibility in the local addendum.
  Cascade key model risk related messages received (e.g., from Group MRPG or from newsletters published) through country teams to ensure awareness.

Inventory and GAME

- Coordinate the model identification process in country and ensure the models are recorded in GAME.
- Ensure model usage is correctly identified within country and recorded in GAME.

- Identify key country specific stakeholders (e.g., country level Model Users also known as model champions) and coordinate engagement as required with Group level stakeholders (e.g., Group Model Sponsors or Model Owners) to drive local country inventory re-affirmation process on a semi-annual basis and confirm to MRPG.
- Guide local model users on GAME access as required through awareness in country.
- Ensure that country specific information is maintained within GAME, including local approvals, in-country model monitoring results, as applicable, local contacts. Note: where updates are being centrally supported by Group model manager, the responsibility of driving the information validity and upkeep in GAME will, remain with the CRO/ delegate.

Risk Reporting and Committee Governance:

- Ensure suitable attendance for the model related items being discussed (e.g., appropriate seniority and technical expertise is in the meeting, appropriate lines of defence are present to provide justification and challenge, etc.)
- Play a lead role within Country Risk Committees for any model related matters (e.g., breaches in model risk metrics, raising any model related concerns, raising any concerns in relation to local regulatory model approval, escalation of delays).
- Preparing and presenting Country Model RIR at relevant Country or regional governance forums, including rationalizing, country level thresholds (e.g., Executive Risk Committees ('ERC') or Local Model Approval Committees ('LMAC')).

Training

- Coordinate and confirm the list of local nominees for virtual model risk training and e-learnings provided by MRPG to ensure sufficient knowledge spread within country.
- In addition to above, conduct any country specific trainings as required by local stakeholders on model risk topics within country.

Country Level Materiality Considerations

Materiality Ratings of models prescribe frequency and intensity of some activities in the MRM framework (e.g., validation intensity and revalidation frequency) therefore, Country specific model Materiality Ratings should only be adopted for countries where necessary. This is only applicable to select T1 and T2 countries depending on regulatory requirements.

Where countries believe the model materiality determined at Group level is not adequately reflective of materiality at a country level, the Country RFO may establish local materiality ratings. In the absence of a country specific Materiality Rating the Group Materiality Rating will be used as the default.

Note:

- For WRB: Most models are already developed in accordance with local regulations and for local use only, therefore materiality assessment leveraging Group Materiality should be adequate.
- Where country level materiality methodology is deemed necessary, Group MRPG function must be consulted for assistance to develop a country level materiality methodology which could be applied consistently.
- Sign-off from Global Head, Model Risk Management (or delegate) must be obtained prior to implementing Country level materiality methodology.
- Approved Country level materiality must be maintained in GAME.
- Group revalidation frequency will be determined leveraging Group materiality ratings, if specific or additional revalidation is expected by countries, this is to be discussed and agreed with Global Head, Model Risk Management.

20. REFERENCE TO OTHER PROCEDURES

Within Model Risk Management various procedure related documents exist detailing aspects of the governance process. This includes the following:

Procedure	Description
Annual Status Assessment (“ASA”)	DOI on annual status assessment requirement where the models are assessed if it is still working as intended
Consolidated MI	DOI on consolidation of MI data for model risk reporting purpose
Group Model Risk Information Report	Report specification on Model Risk Information Report (“Model RIR”) used for internal risk management reporting to MRC
Inventory Review and Management	DOI on MRPG requirement to review and challenge the accuracy and completeness of the model inventory records
Model Issue tracking and Management	DOI on MRPG requirement to provide oversight on open issues
Model performance monitoring and PMA	DOI on MRPG requirement to ensure model monitoring is carried out in line with the applicable MFS and review the use of PMA
Model Risk GRC Update	Report specification on Group Model Risk Update Report used for internal risk management reporting to GRC and BRC
RA Metrics Reporting	DOI to monitor and report the Risk Appetite (“RA”) metrics related to Model Risk
Dispensation Management	DOI for obtaining dispensation from policy / standards requirement
RWA_ECL_Mapping_Process	DOI covers the mapping logic for extracting the RWA and ECL numbers from their respective source system to GAME Dashboard reporting and its associated controls and review processes

21. APPENDIX: SUMMARY OF ACTIVITIES

Role	Activities
Model Sponsor (or delegate) (Business / Product / Function Head)	• Accountable executive responsible for the model risk arising from models for which they are the assigned Model Sponsor • Assign model ownership role for in-house and third-party models • Sign off on ToR • Approve third-party selection and contractual arrangements • Endorse Model Approval Request template • Endorse requests for provisional approval and dispensations to policy • Endorse the application of PMA to material (3,4) models • Endorse model issue extensions for material weaknesses on material models • Together with the Model Owner, identify relevant SMEs to review and assess results from UAT/UVT processes • Awareness of model performance results and any breaches in model performance thresholds • Awareness of repeat applications of model overlays • Responsible for ensuring model issue remediation is suitably prioritized • Risk Acceptance of identified Concerns / Immaterial Issues • Provision of Annual Attestation requirements in relation to models under their purview • Signoff on Decommission of Models
Model Users (Primary or Secondary Model Users)	• Providing feedback as part of the model development process in relation to user testing • Responsible, in conjunction with Process Owners, for the identification and confirmation of models and DQM used within their Business, Product, or Function units • Understanding the approval status of models used including any model limitations, restrictions of model use, and for providing input to the Model Owner as part of the model approval process • Verification requirements prior to Go-Live within their owned processes
Model Owner[42] (Function supporting Model Sponsor on model development, implementation, maintenance and monitoring)	• Accountable executive for the model development process for specified models • Represent the Model Users and ensure all the model use cases are considered within the model life cycle activities • Responsible for the overall model design process including engagement with Model Users to solicit feedback on the proposed model solution • Responsible for providing annual project plan covering known major projects and quarterly updates to address any plan changes

[42] In practice, there may be certain activities that are shared across Model Owner and Model Developer roles, and in some cases (e.g., smaller model families) the Model Owner may also be the Model Developer. In all cases the accountability for the model lies with the Model Owner.

Role	Activities
	• Responsible for coordinating the submission of the model for validation, and submission of the approval package for consideration • Responsible for coordinating with Process Owners and Model Users in relation to model approval, implementation and decommission • Responsible for proposing Model Risk Ratings for new models taking into consideration input from Model Developers • Responsible for working with Model Developers to assess residual model risk, and with Process Owners in relation to any required model overlay and model monitoring processes • Responsible for working with Process Owners and Model Users to ensure models perform as expected and are only used for their approved use cases (control framework) • Accountable for the accuracy and completeness of their inventory records, including upload of completed model documentations to GAME and semi-annual attestation process • Responsible for ensuring training is delivered to Model Users to enable an understanding of any model limitations and approved model use cases • Responsible for ensuring third-party model compliance with GMRP and relevant Standards (on a “best efforts” basis) • Sign off on ToR together with Model Sponsor • Ensure any required tollgate meetings are scheduled, with members of GMV and other relevant stakeholders (e.g., Model Developers, Model Users, Model Sponsors etc.) • Sign off on final completed TDD • Responsible for end-to-end remediation of model issues for which they are accountable • Responsible for ensuring Model Approval Request is completed, including external approval requests (where applicable) • Determine model change classification as part of Model Family Standards specification • Signoff of UAT results provided as part of Model Implementation • Signoff on Decommission of Models
Model Developer[42] (Function supporting Model Owner in model development activities)	• Individuals responsible for the development of models acting as a delegate or agent of the Model Owner • Responsible for documenting and testing the model in accordance with Policy requirements • Responsible for engaging with Model Users, as directed by the Model Owner, as part of the development process • Responsible for providing input to the Model Owner when assessing the Model Risk Ratings for new models • Responsible for highlighting key sources of residual model risk for consideration by the Model Owner
Process Owners (Business/Function managers responsible for the end-to-end processes)	• Work with Model Users, for the identification and confirmation of models and DQM used within their Business, Product, or Function processes

Role	Activities
	• Coordinate with Model Owners and Model Users in relation to model implementation and decommission • Work with Model Owners in relation to model overlay processes and model monitoring processes • Completion of any owned inventory fields in GAME • Work with Model Owners and Model Developers in relation to Model User testing requirements
DQM Owner (Owners of DQM)	• Responsible for identification DQM they own • Responsible for ensuring DQM they own are registered in the Group DQM Inventory • Responsible for tiering DQM in accordance with requirements in the Group DQM Standard and applicable Model Family Standards • Responsible for ensuring appropriate governance and management controls are applied to the DQM in accordance with the DQM tiering.
Model Validation (Group Model Validation ('GMV') function unless otherwise authorized)	• Document validation standards • Provide independent written feedback on Tollgate Template following tollgate meetings and upload the final tollgate template to GAME • Responsible for accuracy and completeness of validation related data in GAME • Sign off on ToR for third-party models • Responsible for validation planning • Consulted on early stages of vendor procurement process for third-party models • Responsible for independent model validation / revalidation process and activities • Sign off on final completed TVR • Complete Continued Use Approval Request Template • Review and challenge proposed monitoring metrics and thresholds • Review and challenge model overlays • Confirm on minor change classification for MRR RR2/RR3/RR4 • Document model re-activation decision process on Model Re-activation Template • Review and challenge of assigned model risk ratings and provide updates in GAME where required • Raise and document issues identified as part of model validation / revalidation process, ongoing monitoring, or ASA process • Review and challenge in relation to proposed closure of model issues • Signoff UAT results as part of Model Implementation process
Model Risk Policy and Governance ('MRPG')	• Coordinate and administer the GMRP, Standards and associated templates • Review and challenge of accuracy and completeness of model inventory records

Role	Activities
	• Oversight of progress of open model issues against action plans • Effective review of model monitoring via oversight process • Coordinate Annual Status Assessment process • Sign off on finalized Model Decommission Plan • Manage model re-activation process and sign off on Model Re-activation Template • Verify next revalidation date arising from new MRR • Responsible for assisting and advising countries in relation to local model risk governance requirements