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Articles submission guidelines
Argo welcomes the submission of articles on topical subjects related to the risk management. The articles can be indicatively, but not exhaustively, related to models and methodologies for market, credit, liquidity risk management, valuation of derivatives, asset management, trading strategies, statistical analysis of market data and technology in the financial industry. All articles should contain references to previous literature. The primary criteria for publishing a paper are its quality and importance to the field of finance, without undue regard to its technical difficulty. Argo is a single blind refereed magazine: articles are sent with author details to the Scientific Committee for peer review. The first editorial decision is rendered at the latest within 60 days after receipt of the submission. The author(s) may be requested to revise the article. The editors decide to reject or accept the submitted article. Submissions should be sent to the technical team (**info@iasonltd.eu**). LaTeX or Word are the preferred format, but PDFs are accepted if submitted with LaTeX code or a Word file of the text. There is no maximum limit, but recommended length is about 4,000 words. If needed, for editing considerations, the technical team may ask the author(s) to cut the article.

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Dear Readers,

We are delighted to present the new issue of Argo Collection, dedicated to Internal Models, a cornerstone of modern risk management and regulatory compliance.

In recent years, internal models have undergone significant evolution, driven by supervisory expectations and technological advancements. The latest revision of the ECB Guide to Internal Models, published in July 2025, introduces important changes that reshape the way institutions design, validate, and govern these models, ensuring greater transparency and robustness across the entire lifecycle.

*To explore these developments, we begin with "**ECB Revised Guide to Internal Models – Overarching Principles for Internal Models**", authored by Marco Carminati, Luca Capitanio, Luigi Esposito, Michele Ferrandino, and Marco Musto. This article examines the fundamental framework institutions must follow when implementing internal models, with a particular attention to the integration of machine learning techniques. The authors highlight how the updated principles clarify governance, monitoring, and validation requirements, reinforcing accountability and control even when advanced methodologies are employed.*

*The issue continues with "**ECB Revised Guide to Internal Models – Credit Risk**", by the same authors, offering a detailed analysis of the changes in credit risk parameter estimation, including prescriptive approaches for PD and LGD calibration and enhanced governance requirements.*

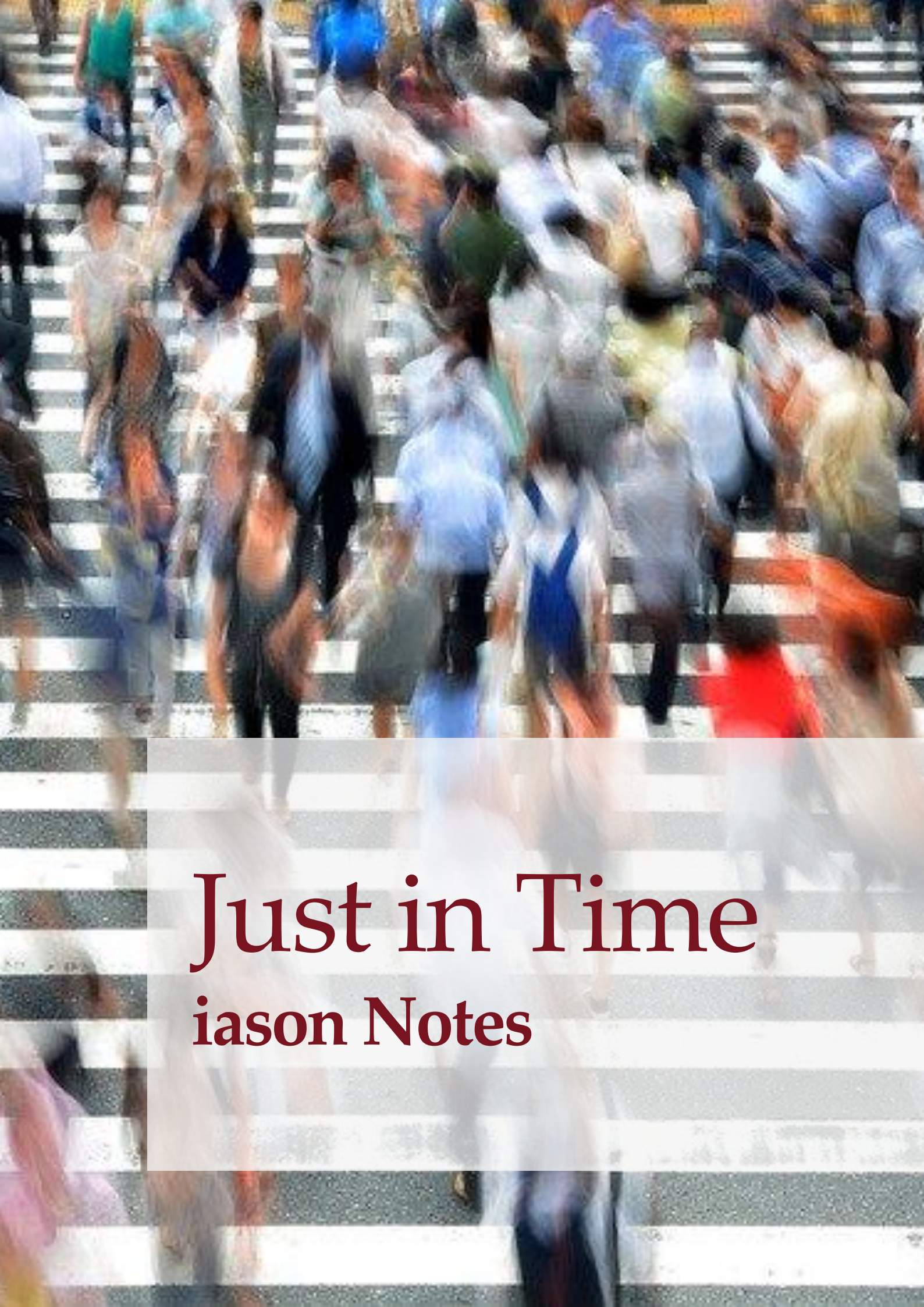
*Finally, "**ECB Revised Guide to Internal Models – Market and Counterparty Credit Risk**", by Martina Cattaneo, Angelo Di Bello, and Mauro Zaccaria, provides an in-depth examination of the ECB's revised framework for Market and Counterparty Credit Risk. The contribution outlines the main changes compared to the previous edition, illustrating the most significant methodological innovations. These include a new section dedicated to CRR3, limited updates for CRR2 Market Risk and Counterparty Credit Risk, and enhanced governance framework. The article also discusses the implications of these changes for banks' risk practices within both regula-*

tory and managerial contexts.

We conclude suggesting you visit our online Research page and subscribe to our newsletter service with a monthly update on the most relevant topics about practical Risk Management.

Enjoy your reading and all the best for the coming year!

Luca Olivo
Giulia Perfetti
Lorena Corna



Just in Time

iason Notes

Credit Risk Meets Large Language Models

The study addresses the issue of information asymmetry in peer-to-peer lending, where lenders often lack sufficient data to assess borrower credit. By applying BERT (Bidirectional Encoder Representations from Transformers), a Large Language Model, the authors generate a credit risk score based on the borrowers' description of the credit request. Once integrated into a XGBoost model with traditional inputs, this score improves predictive accuracy and AUC (Area Under Curve), demonstrating the value of combining textual insights with standard credit data.

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Date September 2025

Counterparty Credit Risk Exploratory Scenario Exercise

The ECB conducted an exploratory scenario exercise to assess counterparty credit risk (CCR) among 15 Euro-area banks selected based on quantitative criteria derived from 2023 EBA stress test. Participants were mainly banks with high CCR exposure towards non-bank financial institutions (NBFIs).
The exercise focused on vulnerabilities linked to exposures to NBFIs and evaluated banks' stress-testing capabilities under multiple adverse scenarios.

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Date September 2025

Guidelines for Integrating ESG Risks into Stress Testing

The Joint Guidelines developed by the European Supervisory Authorities (ESAs) aim to ensure the consistent integration of environmental, social, and governance (ESG) risks into supervisory stress testing by competent authorities.
These guidelines provide a structured approach for incorporating ESG risks either within existing frameworks or through complementary assessments. They emphasize the importance of clear methodological principles, adequate resource allocation, robust data infrastructure, and effective governance.

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Date August 2025

Artificial Intelligence: Financial Industry Market Overview

Starting Artificial Intelligence, and in particular GenAI, is increasingly being adopted across a wide range of industries, with significant capital investment and a growing number of business functions being reshaped.
The financial industry has traditionally been among the earliest adopters of technological innovation, aiming to enhance productivity and improve operational efficiency. The same trend holds true for AI and GenAI, where the industry continues to be at the forefront of adoption.

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Date July 2025

ICT Risk: Focus on Thread-Led Penetration Testing (TLPT)

Threat-Led Penetration Testing (TLPT) represents a cornerstone of the European Union's strategy to enhance the cyber resilience of financial institutions . Mandated by the Digital Operational Resilience Act (DORA) and operationalized through the TIBER - EU framework, TLPT simulates sophisticated cyberattacks based on real -world threat intelligence to assess an entity's ability to detect, respond to, and recover from advanced threats .

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Date August 2025

AI Agents: An Introduction to Agentic Systems, Market Impact, and Future Risks

The rise of Agentic AI marks a significant step forward moment in the current AI revolution, marked by accelerating technological breakthroughs and massive capital deployment. Unlike previous AI developments, Agentic AI holds the promise of significant practical utility and adaptability, already demonstrating early capabilities as a powerful automation tool, which presents unprecedented opportunities alongside new complexities.

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Date November 2025

iason Weekly Insights

Regulatory/Supervisory Pills

Among iason's various publications we also find the iason Pills.

With these daily Pills, iason aims to offer a summary on information, mostly, of the main regulatory and supervisory news in the banking and finance sector on both Pillar I and Pillar II risks of the Basel framework. The main purpose of these publications is to give the reader an effective, timely and brief overview of the main topics of the moment.

The author of the Iason Pills is Dario Esposito.
read more

Market View

Among iason's weekly insight you can also find the iason Market View, a weekly update on financial market by Sergio Grasso.

The author, with almost three decades of investment experience, presents an accurate analysis of market fluctuations of the week, giving a critical view of observed phenomenos and suggesting interesting correlations with the main world events.
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GOVERNANCE. METHODOLOGY. TECHNOLOGY.

iason is a company specialised in advanced solutions for the **Risk Management** of **Financial Institutions.**

We provide highly qualified **consulting services** in the **methodological** and **technological** fields, together with targeted support for **Data** and **Model Governance** projects in risk frameworks.

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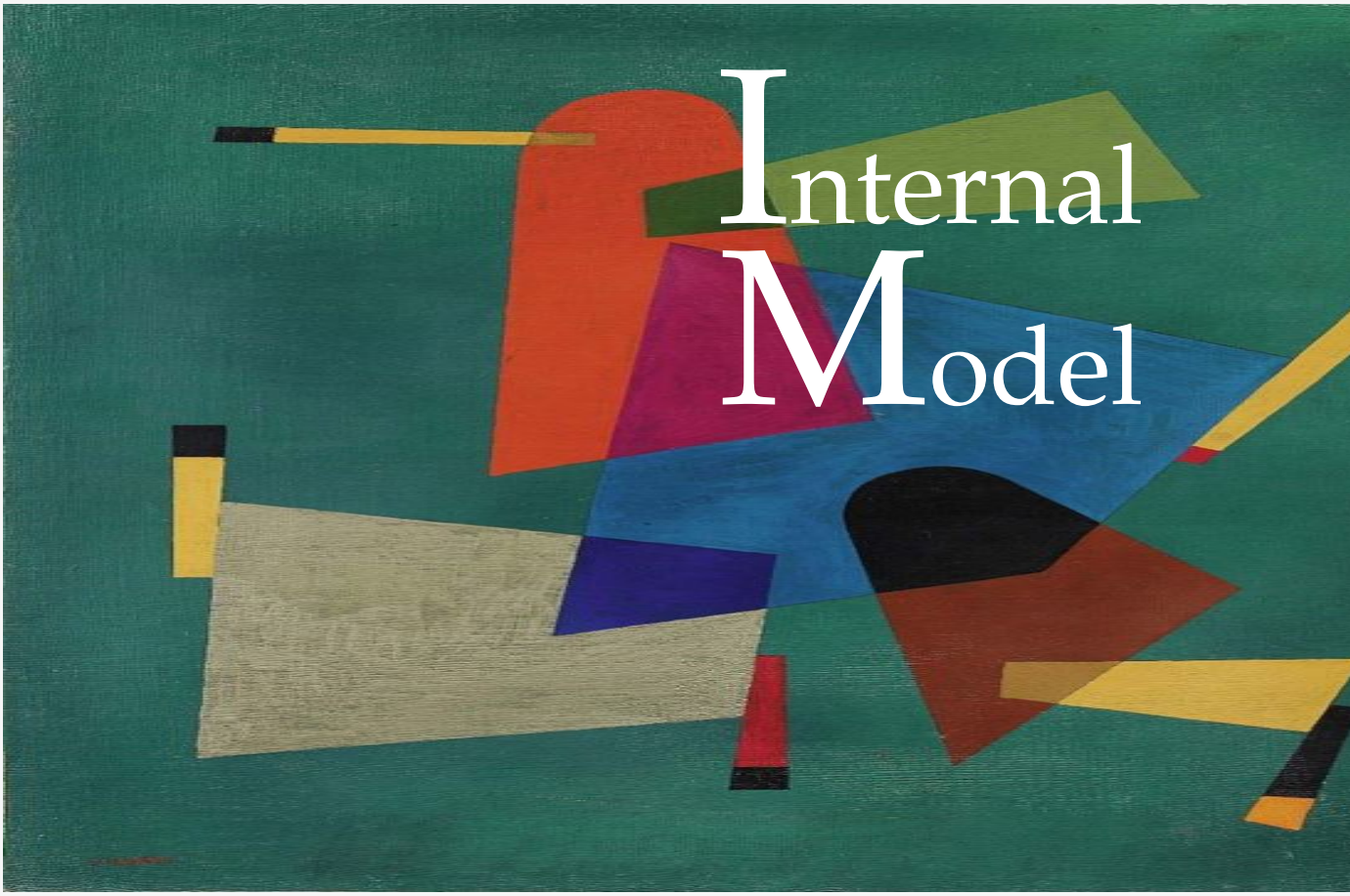

ECB Revised Guide to Internal Models - Overarching Principles for Internal Models

About the Authors

Marco Carminati:
Senior Manager
After taking a Bachelor in Finance and a Master of Science in Economics from Bocconi University, he specialized in Credit Risk Management and Modelling through over 10 years of experience in both banking and consultancy industry. He mainly worked in projects related to development and validation of models for Credit Risk for regulatory (both Pillar I and Pillar II) and managerial purposes with both traditional statistical techniques and Machine Learning techniques. He is deeply interested in ESG issues and earned a Master in Strategy and Management of Corporate sustainability from 24Ore Business School along with the Online Certification Program in Sustainability and Carbon Footprint Auditing from POLIMI Graduate School of Management of Milan Polytechnic. Currently in charge of several projects in the Credit Risk Management area and Head of the iason Credit Risk Competence Center.

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After obtaining a MSc in Economics and Finance at University of Milano-Bicocca, he had a first job experience within the Local Credit Risk Validation team at a big European bank in September 2023 working on project mainly focused on the validation of internal Credit Risk models and research activities on a new homogeneity test to implement into the validation framework. In February 2023, he joined iason as Quantitative Analyst working within the Credit Risk team in the resolution of findings of Credit Risk models.

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Manager
Graduated in Statistics, he is currently supporting the Internal Validation Area of a major Italian bank regarding Credit Risk.

This report provides an overview of the main changes introduced with the July 2025 issue of the ECB Guide to Internal Models with respect to the version dated February 2024, focusing on the Credit Risk chapter. Its purpose is to highlight the key updates introduced and their potential implications for internal modelling and risk parameters calibration.
The most relevant changes concern the section "Estimation of credit risk parameters", specifically regarding the Risk Quantification for PD and LGD. For PD, the revised Guide introduces a more prescriptive framework for the calibration of the Long-Run Average (LRA) default rate, requiring a formal assessment of the representativeness of historical data and an explicit analysis of correlations between internal default rates and macroeconomic indicators. Regarding LGD, the ECB now provides clearer methodological expectations for downturn LGD calibration, including the calculation of a benchmark reference value to be compared against internal estimates. Additional updates have also been introduced regarding the calculation and regulatory treatment of IRB Credit Conversion Factors (CCFs), further clarifying scope, reference points, and methodological requirements.
Additionally, the 2025 update of the ECB Guides to Internal Models also introduces some changes in terms of requirements relating to the scope of application IRB approach, the governance of the roll-out plan for the IRB approach, as well as for the implementation of the F-IRB approach for LGD and CCF. On top, in terms of internal governance, more explicit requirements for senior management responsibility are also envisaged. As for Internal Validation, alignment with the EBA Supervisory Handbook for Validation is strengthened and, as for Internal Audit, further responsibilities are envisaged, especially concerning data quality and machine learning techniques.

The chapter on **overarching principles for internal models** in the 2025 issue of the ECB Guides to Internal Models [6] outlines a series of **general requirements** that institutions using internal models subject to supervisory approval for the calculation of own funds requirements for **credit**, **market**, and **counterparty credit risk** (i.e., **Pillar 1 models**) are expected to meet.
The document is structured to provide a **clear and systematic comparison** between the **February 2024 [5] and July 2025 [6] versions of the ECB Guide to Internal Models**, with the aim of highlighting the **key changes** and their **potential implications for internal modelling practices** in relation to the overarching principles. Each chapter is designed to guide the reader through the most relevant updates in a structured way. Specifically, each chapter begins with a **section describing the main updates** introduced with the revised version [6], if present. This is followed by a comprehensive **summary of the envisaged requirements**, emphasizing the key elements and any methodological considerations that may be affected by the updates introduced with the new issue of the ECB Guide to Internal Models [6].
In chapters where no significant changes have been identified, a **general overview** of the main requirements is provided, while a higher degree of information is provided for those areas that have witnessed **substantial changes with respect to the previous issue** [5].
While most of the prescribed principles were already included in the previous edition of the ECB Guides to Internal Models, the 2025 issue [6] also introduces **new or enhanced requirements**. These relate to **data governance**, the **implementation of model risk management framework**, **third-party involvement** -in particular with respect to **risk factor modellability assessment** in the context of **market risk models**, as well as the **use of machine learning techniques** in internal models. In particular, the chapters in which notable updates have been identified include:

- **Data governance**: constituting an ex-novo section in the overarching principles section, although previously ad-

dressed within risk-specific chapters;

- **Implementation of a model risk management framework**;
- **The use of machine learning techniques in internal models**;
- **Third-party involvement**.

Guidelines at Consolidated and Subsidiary Levels

Banking groups must ensure consistent implementation of internal models **across all entities**. This can be achieved through **binding group-wide principles** or by ensuring that **each entity** has **consistent**, independently **audited local guidelines**. Ongoing controls, such as periodic monitoring and gap analyses, should verify **proper local implementation** and identify **discrepancies**. Group policies must define when deviations are acceptable and require that such cases be **reported to the parent entity**. The effectiveness of these policies must be **regularly monitored and assessed**.

Documentation of Internal Models

All internal models must be **fully documented** so that an independent expert can **understand**, **replicate**, and **assess** them. Institutions should set **principles and guidelines** for documentation, including governance rules and defining the scope by model type. Documentation must cover **methodology**, **assumptions**, **data processes**, **user instructions**, and **validation results**.
A **register** of all internal models must be maintained, listing for each model its owner, purpose, materiality, approval date, usage restrictions, weaknesses, changes, and versioning. Third-party models must also be included.
Institutions must control and review the register and related documentation **annually**, with clear policies for document management, change control, archiving, access, and information completeness. Documentation must be kept current and retained according to **legal and regulatory requirements**.

Data Governance

The ECB [6] expects sound **data governance** for all **data used as inputs for internal models**. In particular, institutions are expected to set up adequate **organisational measures for data management and security** throughout the data lifecycle, especially ensuring that the management body can monitor data security and enable a timely reaction to detected breaches. Such measures are expected to take **common standards** into account (e.g., Digital Operational Resilience Act (DORA) [7] or the Basel Committee on Banking Supervision (BCBS) [1]).
Additionally, when the **target variable** is determined by **human judgement**, institutions are expected to have a data governance process ensuring consistency in the labelling performed. This should include, in particular, clear guidelines on how to apply human judgement as well as regular analyses ruling out systematic differences in the labelling performed by different individuals.

Implementation of a Model Risk Management Framework

Effective model risk management allows institutions to reduce the risk of potential losses and underestimation of own funds requirements as a result of flaws in the development, implementation or use of the models.
To mitigate these risks, the ECB expects institutions to establish a **model risk management framework** that includes, at a minimum, a written model risk management policy, a register of the institution's internal models, guidelines for identifying and mitigating areas of measurement uncertainty and known model deficiencies in line with their materiality. The framework should

Main Changes
The ECB has introduced a dedicated section on **data governance** within the overarching principles, consolidating requirements previously spread across risk-specific chapters. Institutions must ensure robust data governance for all **data used as inputs for internal models**, with **organisational measures for data management and security** to be aligned to **common standards**. Where **human judgement** defines **target variables**, consistent labelling must be maintained through clear guidelines and regular checks for bias and inconsistencies.

TABLE 1: Main updates related to data governance.

Main Changes
In relation to the **model risk management framework**, with the 2025 issue of the ECB Guides to Internal Models the ECB now requires institutions to ensure that all **stakeholder groups** involved in model risk management possess the **appropriate levels of skills, capabilities and expertise**, to be **reviewed regularly** and supported by appropriate **training programmes**. Additionally, each internal model is now expected to undergo **regular complexity assessments**, aimed at identifying models as **highly complex** or **dynamic**.

TABLE 2: Main updates related to implementation of a model risk management framework.

also encompass guidelines and methodologies for the qualitative and/or quantitative assessment and measurement of the institution's model risk, guidelines covering the model life cycle, procedures for model risk communication and reporting (internal and external), as well as a clear definition of roles and responsibilities.

In addition, with the 2025 issue of the ECB Guides to Internal Models [6], institutions are now also expected to include in their model risk management framework the **appropriate levels of skills, capabilities and expertise** for each **stakeholder group**. These are, in particular, expected to be commensurate with the institution's model risk and with the duties of each stakeholder. Furthermore, institutions are also required to set up appropriate **training programmes** for all the stakeholder groups to ensure that these appropriate skill levels are reached and maintained. These should also be **reviewed regularly** to ensure that stakeholders are consistently able to manage model risk.

Moreover, each internal model is now also expected to undergo a **regular complexity assessment**, capable of classifying internal models according to their complexity. In particular, institutions are required to clearly identify internal models as **highly complex** (e.g., due to the use of ML techniques) or **dynamic** (i.e., models that are able to adapt, recalibrate or otherwise change autonomously in response to new inputs).

Identification of Management Body and Senior Management

Institutions must clearly define and document the **roles and responsibilities** of the management body and senior management regarding internal models and each risk type, in line with Article 3(1)(7) and (9) of

the CRD and national law. The documentation must specify the composition of **both governance levels**.
The management body includes executive members in either one-tier or two-tier systems. Their individual roles and responsibilities must be **documented**. Institutions should assess whether management committees adequately **support decision-making**, particularly on material internal model matters. Committee composition, mandate, reporting lines, and decisions must be clearly recorded. Each committee must operate under a **formal mandate** approved by the management body and be chaired by one of its members.
Senior management must be identifiable for credit, market, and counterparty credit risk models. It represents the highest level below the management body responsible for internal models and must report to it or provide necessary information for oversight. Decision-making processes related to internal models must be fully documented.

General Principles for Internal Validation

All internal models and estimates must undergo an **initial validation** — covering new models, material changes, and extensions — and **annual revalidation**. Institutions must ensure the validation function operates independently from model development through proper organisational separation.
The ECB recognises **three possible setups**:

- Two separate units reporting to different senior managers;
- Two separate units reporting to the same senior manager;
- Separate staff within one unit.

The chosen structure must reflect the institution's **size**, **complexity**, and **risk profile**. Large and complex institutions should adopt the most independent setup. When using option (b), institutions must comply with Article 10(3) of Regulation (EU) 2022/439 and ensure internal audit reviews compliance. Option (c) is **acceptable only for smaller**, non-systemically important entities, subject to Article 10(4) of the same Regulation.
Staff in validation must be **independent** from those in model development to prevent **conflicts of interest**. The validation function must be adequately resourced, staffed with qualified and experienced personnel, and capable of providing an effective independent challenge to internal models and estimates.

General Principles for Internal Audit

Internal models must undergo regular reviews by an **independent internal audit function**, as required by the CRR [8] and in line with EBA internal governance guidelines [3]. These reviews must be **efficient**, **objective**, and **effective**.
Internal audit must be **independent** from all processes and units it reviews, including model operations, validation, and risk control. It must **report** directly to the management body and operate free from external influence.
The audit function must have sufficient resources, qualified and experienced staff, and an organisational structure **proportionate** to the institution's size and complexity. Best practices include:

- Reporting audit **conclusions**, **findings**, and **recommendations** to the audit committee or relevant management;
- Ensuring **action plans** to address weaknesses are approved and monitored for timely implementation, supported by IT tools;
- Preparing at least **annual status reports**, discussing them in relevant committees, and submitting summaries of audit results, action plans, and follow-up status to the competent authority.

General Principles on Climate-related and Environmental Risks

Institutions must assess the materiality of all risks throughout the internal model lifecycle, including **climate-related and environmental risks**. When these risk drivers are relevant and material, they must be **incorporated into internal models** used to calculate own funds requirements for credit, counterparty credit, and market risk.

The Use of Machine Learning Techniques in Internal Models

General Principles on Internal Models Making Use of Machine Learning Techniques

In the ECB's understanding [6], **Machine Learning (ML) techniques** encompass models that are characterised by a **large number of parameters**, with the ability to **represent highly non-linear functions**, and/or the need for **substantial data volumes** for calibration (i.e., training). These techniques typically involve **complex statistical methodologies** that often exhibit a **limited degree of explainability or interpretability** compared to traditional modelling approaches.

The ECB [6] considers the employment of ML techniques in internal models to be an **overarching topic applicable to all internal models used for Pillar 1 purposes**, regardless of the underlying risk type. Consequently, although the provisions of the 2025 issue of the ECB Guide to Internal Models [6] are **primarily tailored** to **credit risk** -and therefore constitute the legal basis for this specific risk type — the ECB has, where feasible, **extended such principles** to **market risk** and **counterparty credit risk** as well.

The implementation of these principles is expected to follow a **proportionality approach**, that is by taking into consideration the **complexity** of the internal models employing ML techniques and their specific **area of application within internal models** (e.g., data preparation, modelling, challenger tools, etc.).

Furthermore, the ECB [6] also expects the use of ML techniques to be considered as a driver in their **complexity assessment** and, consequently, in their **materiality assessment**. All else being equal, it is expected that ML-based internal models are more like to be classified as **material** than those based on traditional techniques, with subsequently higher expectations towards management reporting and internal validation.

Governance of Machine Learning-based Internal Models

Institutions are expected to integrate the risks associated with ML-based internal models in their **governance frameworks and processes**. In so doing, they are required to ensure that all relevant **stakeholders possess the necessary skills, capabilities and expertise**. Consequently, this expectation extends to all three lines of defence, which should be fully aware of the specific challenges posed by the deployment of ML techniques within internal models.

The **main stakeholders** in contact with ML-based internal models within the institution (i.e., development function, validation function, internal audit, model users, senior management and the management body, as well as the risk committee) are particularly expected to possess **sufficient skills, capabilities and expertise** regarding ML techniques to discharge their duties in managing model risk. Additionally, where institutions determine **own funds requirements** at the consolidated or individual level, they must ensure that **adequate internal expertise in ML techniques** exists within **each relevant legal entity**.

Institutions are also expected to ensure that their **changes policy** clearly **defines** what constitutes a **change** in terms of **ML-based internal models**. The change policy is expected to include **clear criteria** to distinguish between changes that qualify as changes to the internal model and those

Main Changes
The requirements relating to the **use of machine learning techniques** in internal models constitute the **main novelty**, as these were entirely absent from the previous issue of the ECB Guides to Internal Models. The ECB defines Machine Learning (ML) as encompassing models characterized by **a large number of parameters**, **high non-linearity**, and **significant data requirements for training**. Such models often have **limited explainability** compared to traditional approaches. The ECB provides **detailed guidance** on **ML-based internal models**, covering a wide range of areas including **governance**, **internal validation** and **audit**, **data and IT governance**, **methodology**, as well as the **use of human judgements**.

TABLE 3: Main updates related to the use of machine learning techniques in internal models.

that do not. In the specific case of **market risk**, such criteria are expected to **distinguish** between changes to the ML techniques to be interpreted as **model changes** and those to be understood as **model maintenance**. As a general rule, the **initial transition from** a predominantly **traditional modelling** approach **to** a primarily **ML-based** one is expected by the ECB [6] to be treated as a **material change**.
When ML techniques are employed, particularly in the case of **dynamic models**, institutions are also expected to duly consider the following requirements in their assessment leading to the classification of **model changes**:

- A **significant change in the rank or i the distribution of exposures** should be considered a **material change**;
- A material change **must not be fragmented** into multiple changes or extensions of lower materiality to avoid appropriate classification.

Additionally, in the case of **dynamic ML-based internal models**, institutions are also expected to:

- Justify the **reason for such approach**;
- Effectively **monitor the evolution** of the internal model on ongoing basis;
- **Assess the performance** of the internal model regularly;
- **Evaluate the impact of updates** on model outputs;
- Determine whether such **updates** could lead to **unexpected or undesired changes** in the logic of the internal model and how this could affect its use in the institution's activities or decision-making.

The **change policy** is expected to encompass a suitable and documented **monitoring process** to identify changes, prevent the automatic implementation of material changes and of non-material changes requiring ex ante notification, and recognise model drift (i.e., changes in the model's performance). Finally, the monitoring is also required to indicate if and when a series of automatic non-material changes leads to a material change in the model.

Internal Validation of Machine Learning-based Internal Models

Internal validation policies and procedures are expected to **explicitly** account for the use of **ML techniques** in internal models or in the validation process itself, in particular:

- Internal validation is required to effectively **challenge the modelling decisions** regarding ML-based internal models, assessing whether their **complexity** is **justified**, and **evaluating** the **stability** and **robustness** of the outcomes with respect to other possible approaches taken, hyperparameters selected and the randomness of the training process. Internal validation should also assess the implications of the ML techniques used within the internal models being able to fit the training dataset beyond its generalisation capacities (including **overfitting**) and should pay particular attention to the **performance** of ML techniques and ML-based internal models measured using **out-of-sample** and **out-of-time** data.

- The **frequency** of the validation activities is expected to be commensurate with the ML-based internal **model complexity and model risk**, meaning that the appropriate frequency for performing the activities might actually be **higher for ML-based internal models**, so as to ensure that any material deficiency is detected within a reasonable time period.

- Institutions are expected to rely on a **set of explainability techniques and tools** when carrying out internal checks to reliably identify circumstances where a **ML-based internal model is not working effectively** (Article 175(4)(c) of the CRR) [8], the **causes for a deterioration** in the model **performance** and **stability** (Article 174(d) of the CRR) [8], as well as the **reasons** for the **deviation in the risk estimates from their realised values** (Article 185(e) of the CRR) [8].

- On top of the analyses of the ML-based internal models themselves, the internal validation activities are also expected to cover the analyses regarding the **explainability techniques and tools used in conjunction with the ML-based internal models**. These analyses should be performed at least yearly, addressing in particular the **adequacy and appropriateness of the chosen explainability techniques and tools**.

Internal Audit of Machine Learning-based Internal Models

When performing the **general risk assessment**, the ECB [6] requires the institution to consider whether the use of ML-based internal models leads to **heightened model risk** in the specific area, as it is overall expected that **general model risks increase when ML techniques are employed**.
Depending on the outcome of such assessment, internal audit is expected to set an **appropriate intensity and frequency for the audit engagements** for ML-based internal models. In particular, in the specific case of **highly complex or dynamic ML-based internal models**, the institution is expected to include a **deep dive** in the annual audit work plan. Furthermore, if special information needs, newly identified shortcomings, or unexpected events and developments occur for highly complex or dynamic ML-based internal models, the ECB [6] requires **additional audits** outside of the annual audit work plan be performed.
Additionally, the ECB [6] expects internal audit to assess whether any aspects exist that are particularly relevant for ML-based internal models and, in case they do, internal audit is also required to provide its opinion on such aspects in the general risk assessment.
Finally, to properly audit ML-based internal models, internal audit is also expected to duly consider the **relevance and meaningfulness of the audit techniques applied**.

Data and IT Governance for ML-based Internal Models

Institutions should define standards aligned with best practices and academic research to **strengthen data governance**, assessing the adequacy of data used in internal ML models in terms of type, quantity, and sources, including synthetic or unstructured data.
In addition to general requirements under the institution's **data quality** framework, input data for ML models should undergo an **additional exploratory data analysis** to ensure **proper understanding** of **data formats**, treatment of **missing values**, and identification of **potential sources of bias**.
Institutions must also ensure that their **IT infrastructure** and related **IT governance** processes **adequately support internal ML models**, particularly when handling complex or unstructured data and higher computational workloads. Best practice is for IT systems to provide full **traceability**, **reproducibility**, and **auditability**, including model versioning to track all steps and decisions.
Finally, institutions should **integrate ML-related systems** and **data management** activities into their **outsourcing governance framework** to identify, assess, and mitigate risks arising from third-party arrangements supporting ML-based internal models.

Mathematical Methodology of ML-based Internal Models

In this section, the ECB [6] clarified methodological expectations for ML-based internal models, stressing the importance of a robust **statistical methodology**, control of **overfitting** and **underfitting**, and full **replicability** of the modelling process. The ECB [6] also introduced detailed expectations on model **complexity** and **explainability**, ensuring that ML methods remain transparent, interpretable, and supported by a clear **economic rationale**.
The design and parameter estimation of ML-based internal models must be supported by a sound **statistical methodology**, including appropriate justification of model structure and parameter choices based on statistical or optimality criteria. Institutions should monitor and mitigate risks of **overfitting** and **underfitting**, ensuring the appropriate level of **model complexity** and identifying all relevant hyperparameters.
To ensure proper **replicability**, the documentation must include all relevant parameters, hyperparameters, random seeds, and, when applicable, the ordering of training data. The ECB [6] expects institutions to demonstrate a clear **economic rationale** for the choice of **model structure** and **input variables**, **justifying any increase in complexity** relative to the **improvement in model performance**.
Where the **explainability** of ML-based models is **reduced** due to complex functional relationships, institutions should **apply suitable explainability techniques and tools** to assess and quantify the contribution of individual risk drivers globally and locally.
Institutions must **document** their chosen **explainability techniques**, including the criteria used for evaluation, their limitations, and their relevance to different stakeholders, ensuring explanations are robust, accurate, and actionable for **human oversight**.

Use of ML-based Internal Models

Institutions should **clearly define** in their internal policies the **scope**, **purpose**, **applications**, **functionalities**, and **limitations** of ML-based internal models within risk management, credit approval, capital allocation, and governance processes. The integration of these models must align with the overall **business strategy**.
Where **ML-based models are not fully leveraged in internal decision-making**, institutions should **document** and **justify** these **exclusions** transparently. When used, institutions must remain vigilant to **potential additional risks**, such as bias introduced by adapting Pillar 1 models for other purposes.

In the context of **internal capital adequacy assessments**, **ML model** outputs under **stress testing** and **scenario analysis** must be **explainable**, **plausible**, and **not overly optimistic**.

IRB: Human Judgement in Model Use

Institutions must ensure that their **override policies** address **excessive or unjustified overrides** as potential indicators of **weaknesses in ML-based internal models**, particularly concerning **model design** and **complexity**. Overrides should be **monitored** to assess their **impact on model performance**, including the marginal **contribution** of **human judgement**, and should distinguish between **input and output overrides**.
All overrides must be thoroughly **documented**, especially for ML-based models with numerous input variables, detailing any **external data or information** used and its relevance for creditworthiness assessment. Personnel performing overrides must understand the **model's risk drivers** and use **appropriate explainability tools** before making adjustments, documenting the techniques considered.
For ML-based models with extensive input data, **input overrides** require **full transparency** on the variables used in the pre-override output, and both **input and output overrides** should remain **exceptional events**.

General Principles for the Implementation of a Changed or Extended Model

Under Article 3(5) of Delegated Regulation (EU) 529/2014, institutions must apply the approved **material change** or **extension** to their internal models from the implementation date specified in the new permission, which replaces the previous one. Implementation must occur promptly and without undue delay, typically **within three months from the notification date**.
If more time is needed, institutions must request an extension early — preferably with the application — providing **justification**. Extensions are granted only under specific conditions, such as phased implementation across jurisdictions, joint implementation, or IT constraints.
These expectations also apply when reversing the use of **less sophisticated approaches** under Article 149 CRR [8].

Third-party Involvement

Outsourcing in the context of internal models refers to the involvement of third parties in any internal models-related tasks.
In terms of contract requirements, **outsourcing agreements for internal model-related tasks** must be **formal**, **documented**, and **proportionate**, ensuring they **do not hinder model validation**, **supervisory communication**, **or the institution's in-house knowledge**. Agreements should allow **full access for competent authorities**, require third-party **support for regulatory requests**, and include **training** or **workshops** as best practice.
In terms of **third-party involvement in internal validation and internal audit tasks**, outsourcing is allowed provided that **legal requirements are met**, **responsibility remains within the institution**, and the ECB Guide to Internal Models principles [6] are followed, including report approval by management, performance assessment, and maintaining independence of third parties. Tasks outside the EU require prior authority consultation.
In terms of third-party involvement in **internal models development or maintenance**, regulatory and internal requirements must be met, but the institution is required to **retain in-house expertise and have contingency plans**. Tasks outside the EU require prior authority consultation.
Institutions must **retain sufficient in-house knowledge** by ensuring full access to information, providing training at all levels, and maintaining proper oversight of outsourced activities to retain control if necessary. The ECB recommends that, for

Main Changes
With the 2025 issue of the ECB Guide to Internal Models, the ECB considers that, in the context of **market risk**, **mapping risk factors to real price data** for modellability assessments qualifies as **outsourcing** under the EBA Guidelines. Therefore, in the **risk factor modellability assessment**, institutions are expected to carefully review which **data and services from external providers** they use to determine if these fall under **outsourcing** rules. Even when such data or services are not classified as outsourcing, institutions are still required to ensure they are **audited and validated** appropriately.

TABLE 4: Main updates related to the third-party involvement.

third party involvement in model-related tasks, institutions ensure **contract transparency**, **full information access**, **regular** and **on-request reporting**, and that third parties provide **support for regulatory interactions**. When using third parties for **model development or calibration**, institutions should retain **full access to information**, enable **independent validation**, have a **model change policy**, and be able to assess and request model changes. For **IRB rating systems**, institutions should access their own obligor data, assess the **representativeness of pooled/external data**, and understand the **definition of default for risk differentiation and quantification**.

To ensure that they are able to identify and manage the risks connected with internal model-related outsourced tasks, institutions are required to **independently monitor third-party performance**, applying **the same standards for monitoring and audit as in-house operations**, using KPIs, and designated oversight bodies. Additionally, with regard to monitoring **third-party provisioning of external data**, the ECB considers **best practice in-house-equivalent vetting**, **automated quality checks**, assessing representativeness, cross-checking sources, setting KPIs in contracts, and recognizing that data quality is independent of model performance.

Institutions using **external credit risk parameters** must integrate internal data, understand the third party's methodology and assumptions, monitor performance, and retain the ability to audit and trigger model reviews.

Institutions using **pool models** remain fully responsible for rating system integrity and validation, must be able to correct deficiencies independently, and cannot have third parties validate systems they develop, except for tasks requiring pooled data access.

In the context of **market risk**, as classifying risk factors as modellable/ non-modellable typically involves some kind of **mapping of risk factors to real price data**, the ECB [6] considers that this activity falls under the definition of **outsourcing** in the context of IMA models as it would not be covered under paragraph 28 of the EBA Guidelines on outsourcing arrangements [2].

Overall, for the **risk factor modellability assessment**, the ECB [6] expects institutions to carefully analyse which **data and services from external providers** are used and, based on that, to determine if this would fall under **outsourcing** (i.e., under paragraph 28 of the EBA Guidelines on outsourcing arrangements [2]). Nevertheless, also if data and services are not classified outsourcing, the institution is still expected to ensure that these are **audited and validated**.

Topic	New Requirements	Main Activities
Data Governance	Institutions are expected to put in place robust data governance for all data used as inputs for internal models.	• Adopt organisational measures for data management and security aligned with common industry standards (e.g., BCBS); • Establish clear, consistent guidelines for applying human judgment in target variable determination.
Machine Learning	Institutions are required to set up a comprehensive framework for machine learning based internal models.	• Comprehensive ML Governance Framework: Establish a complete governance structure for machine learning (ML)-based internal models. • Integration of ML Risks: Embed ML-related risks into overall governance, ensuring clear accountability, expertise, and controls across all functions (development, validation, audit, senior management). • Enhanced Validation and Audit: Implement robust validation and audit processes tailored to ML complexity, with appropriate methodologies, frequencies, and tools. • Strong Data and IT Governance: Ensure data quality, transparency, and full traceability across the entire model lifecycle. • Methodological Standards and Explainability: apply sound, replicable methodologies, maintain proportional model complexity, and use explainability tools to support transparency and human oversight. • Human Judgment and Overrides: Ensure human overrides are transparent, justified, monitored, and treated as potential indicators of model weaknesses.

TABLE 5: Main conclusions.

Internal Models in the Context of Consolidations

In **mergers and acquisitions**, the use of internal models follows Section 3.4 of the ECB Guide on consolidation [4]. Compliance issues may arise when combining institutions, but existing models may continue to be used if supported by **clear model mapping** and a credible roll-out plan to resolve model-related issues.
Each case requires a **specific ECB decision** detailing compliance issues at the transaction date, planned remediation actions, and transitional arrangements for calculating risk-weighted exposure amounts (RWEAs) during the return-to-compliance process.
Institutions must submit a "return to compliance plan" describing how **compliance** will be restored. The plan must specify:

- The internal model landscape of merging entities, including model types and scope;
- The target model framework for the merged entity;
- The concrete actions and timelines for achieving compliance, including model extensions, new approvals, and IRB-related PPU requests;
- How RWEAs will be calculated during the transition, reflecting the acquiring bank's ability to use the target's models before and after IT integration.

Conclusions

To comply with the updated requirements of the 2025 issue of the ECB Guide to Internal Models [6], institutions are expected to put in **place robust data governance for all data used as inputs for internal models**. This translates into the requirement for institutions to adopt adequate organisational measures for data management and security, which must be based on common standards (e.g., Basel Committee on Banking Supervision (BCBS) [1]), as well as clear guidelines regarding the application of human judgement when this is employed in

the context of target variable determination, thus ensuring consistency in the labelling performed.

Additionally, for institutions to be compliant with the updated version of the ECB Guide to Internal Models [6], they are also required to put in place a **model risk management framework encompassing the appropriate levels of skills, capabilities and expertise that all stakeholder groups involved in model risk management are supposed to possess**. Moreover, these skills should be subject to regular review and appropriate training programmes must also be envisaged to ensure that they are reached and maintained. This now also translates into the requirement for internal models complexity to be regularly assessed, to enable model classification according to its complexity, with the specific requirement of identifying highly complex (e.g., ML-based models) and dynamic models.

Considering the updates introduced with the 2025 issue of the ECB Guide to Internal Models [6], institutions are also required to set up a comprehensive **framework for the governance and use of machine learning based internal models**. Institutions are now required to embed ML-related risks within their overall governance structures, ensuring appropriate expertise, accountability, and control across all relevant functions, spanning from model development and validation to audit and senior management oversight. Furthermore, institutions are requested to put in place **robust internal validation and audit practices**, with methodologies, frequencies, and tools adapted to the **higher complexity and model risk introduced by ML techniques**. Additionally, institutions are expected to possess **strong data and IT governance to ensure data quality, transparency, and full traceability throughout the modelling lifecycle**. Sound and replicable methodological standards, proportional model complexity, and the application of explainability tools to maintain transparency and facilitate human oversight are now also mandatory. Furthermore, institutions must align the use of ML-based models with their strategic objectives, ensuring **explainable and credible outputs in areas such as credit risk management, capital allocation, and stress testing**. Finally, as far as the employment of **human judgement** is concerned, the 2025 issue of the ECB Guide to Internal Models [6] requires that **overrides** are **transparent, justified, and closely monitored as potential indicators of model weakness**.

Finally, in light of the updates introduced with the 2025 issue of the ECB Guide to Internal Models [6] with reference to the **market risk factors modellability assessment**, institutions are now also required to **carefully review which data and services from external providers they use to determine whether these actually fall under outsourcing rules or not**. Moreover, to be compliant with the updated requirements, institutions must also ensure that such data and services are audited and validated appropriately even when these are not classified as outsourcing.

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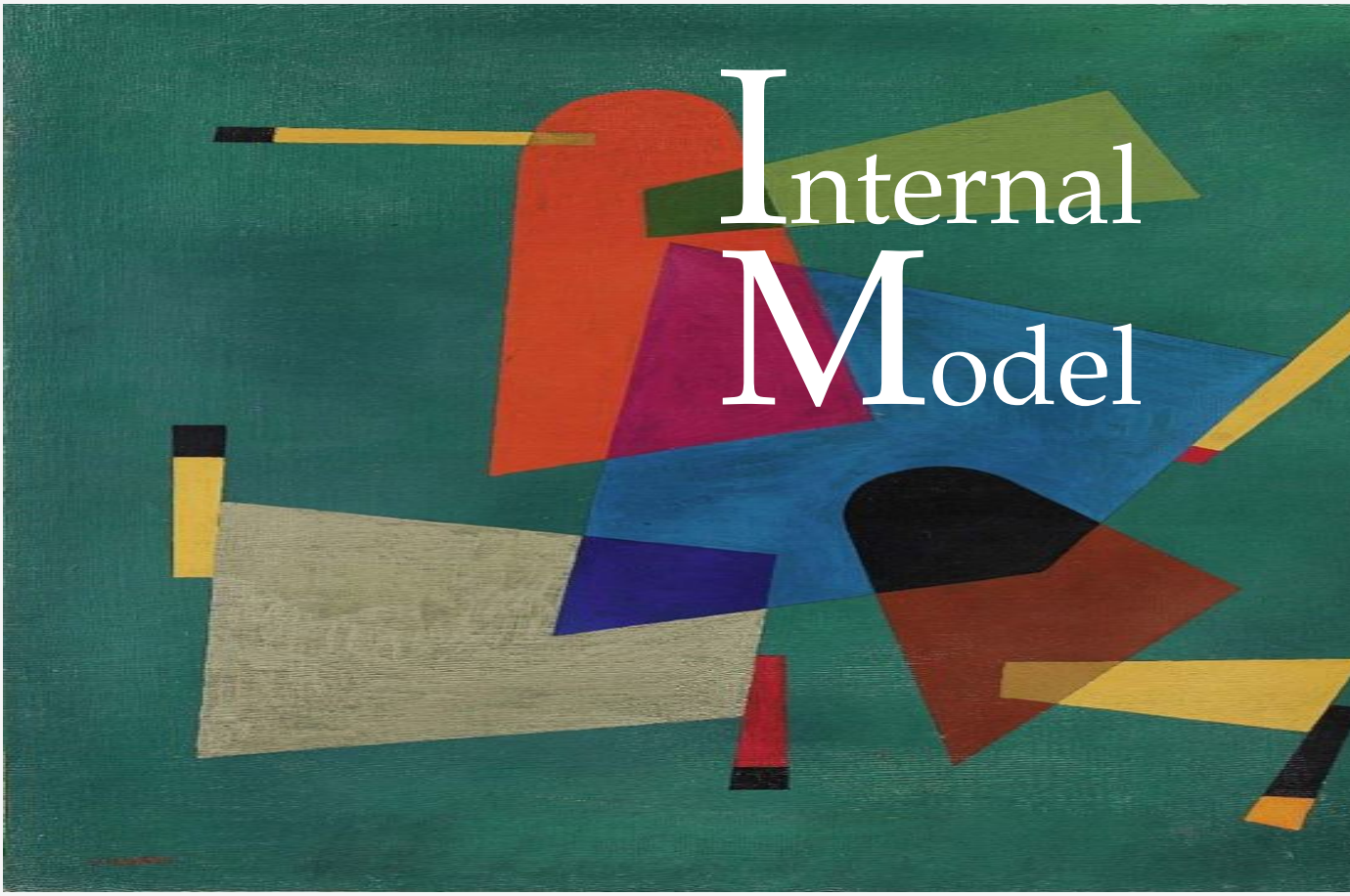

ECB Revised Guide to Internal Models - Credit Risk

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This report provides an overview of the main changes introduced with the July 2025 issue of the ECB Guide to Internal Models with respect to the version dated February 2024, focusing on the Credit Risk chapter. Its purpose is to highlight the key updates introduced and their potential implications for internal modelling and risk parameters calibration.
The most relevant changes concern the section "Estimation of credit risk parameters", specifically regarding the Risk Quantification for PD and LGD. For PD, the revised Guide introduces a more prescriptive framework for the calibration of the Long-Run Average (LRA) default rate, requiring a formal assessment of the representativeness of historical data and an explicit analysis of correlations between internal default rates and macroeconomic indicators. Regarding LGD, the ECB now provides clearer methodological expectations for downturn LGD calibration, including the calculation of a benchmark reference value to be compared against internal estimates. Additional updates have also been introduced regarding the calculation and regulatory treatment of IRB Credit Conversion Factors (CCFs), further clarifying scope, reference points, and methodological requirements.
Additionally, the 2025 update of the ECB Guides to Internal Models also introduces some changes in terms of requirements relating to the scope of application IRB approach, the governance of the roll-out plan for the IRB approach, as well as for the implementation of the F-IRB approach for LGD and CCF. On top, in terms of internal governance, more explicit requirements for senior management responsibility are also envisaged. As for Internal Validation, alignment with the EBA Supervisory Handbook for Validation is strengthened and, as for Internal Audit, further responsibilities are envisaged, especially concerning data quality and machine learning techniques.

The document is structured to provide a **clear and systematic comparison** between the **February 2024 [2] and July 2025 [3] versions of the ECB Guide to Internal Models**, with the aim of highlighting the **key changes** and their **potential implications for internal modelling practices** in relation to **credit risk**. Each chapter is designed to guide the reader through the **most relevant updates** in a structured way. Specifically, each chapter begins with a section describing the main updates introduced with the revised version [3]. This is followed by a **comprehensive summary** of the envisaged requirements, emphasizing the key elements and any methodological considerations that may be affected by the updates introduced with the new issue of the ECB Guide to Internal Models [3].
In chapters where no significant changes have been identified, a general overview of the main requirements is provided, while a higher degree of information is provided for those areas that have witnessed substantial changes with respect to the previous issue [2]. In particular, the chapters in which **notable updates** have been identified include:

- **Application, Rollout and Permanent Partial Use of the IRB Approach**;
- **Internal Governance**;
- **Internal Validation**;
- **Internal Audit**;
- **Probability of Default**;
- **Realised LGD**;
- **Conversion Factors**.

General Topics for Credit Risk

Application, Rollout and Permanent Partial Use of the IRB Approach

As for the **application of the Internal Ratings-Based (IRB) approach**, institutions applying it are **no longer required to extend it to all non-trading book exposures**, as prior approval for each exposure class, rating system and estimation approach for LGDs and CCFs must be obtained. Additionally, once the IRB approach is applied

to a certain type of exposure within a given exposure class, it must be **consistently applied to all exposures in that class**, unless the competent authority has granted permanent permission to apply the Standardised Approach (SA) to specific types of exposures within that same class. In particular, subject to supervisory approval, institutions are now allowed to apply the **SA for immaterial exposures** (e.g., foreign branches, product groups) in terms of size and perceived risk profile (Article 150 CRR [4]).
In terms of the determination of the **appropriate capital requirements calculation approach**, the ECB considers as a best practice for institutions to **define and formalise objective criteria**, while the requirement for institutions to provide detailed quantitative and qualitative criteria is no longer envisaged. Additionally, besides still considering the required operational capability and cost for developing a rating system for the relevant exposure class or type, institutions are now also required to take into account the **availability of minimum representative data** for the development of a rating system.

Furthermore, institutions already applying the IRB approach must ensure that their **internal model landscape is rationalised based on a group-wide strategy**, previously discussed with the competent authority.
With regard to the governance of the roll-out plan for the IRB approach, since the roll-out plan governs the application and phased implementation of the IRB approach for each exposure class, it should be approved by the institution's senior management and management body. In particular, on top of reporting the status of the roll-out plan to the management body regularly (at least annually) and ensuring that such reports are inclusive of the precise scope of application, the expected approval and/or implementation dates, as well as the initial, current and planned exposure amounts and RWEAs, institutions are now required to have **a status report covering the exposure classes for which the future use of the IRB approach is envisaged**.
Institutions should also establish a governance framework or policy for the roll-out plan, which includes:

- Identification of the internal bodies responsible for approving the roll-out plan and any amendments;
- The frequency of reporting on the implementation of the roll-out plan to the management body and the competent authority;
- The criteria for introducing changes to the roll-out plan;
- Controls to assess compliance with the roll-out plan.

Any **changes to the roll-out plan** approved by the competent authorities (or any extension of the IRB approach use) are subject to a supervisory decision. In so doing, the ECB assesses any request for a modification of the roll-out plan on the basis of the documentation provided by the institution regarding the rationale for the change, the materiality of the affected portfolios, and the governance arrangements foreseen for the modification. In addition, institutions should also consider the following aspects:

- Resource constraints and reprioritisation may affect the operational capacity to develop and maintain rating systems;
- General regulatory uncertainty affecting the IRB approach should not constitute a valid justification for amending or delaying the implementation of the roll-out plan.

Regarding the **monitoring of compliance with permanent partial use provisions and less sophisticated approaches**, to ensure continuous compliance with the conditions laid down in the CRR [4] for exposures under permanent partial use (PPU), the ECB requires institutions to implement the following:

- Measures and triggers to reassess the eligibility of exposure types au-

thorised under PPU (including exposures of foreign branches and different product groups) within each exposure class for which the IRB approach is applied;

- A reporting process to monitor the materiality of PPU exposure types within an exposure class over time;
- Processes and guidelines to assess whether additional exposure types may become eligible for PPU.

Additionally, **for IRB exposures for which internal LGD or IRB-CCF estimates are not used, institutions must collect and retain data to compare realised LGDs and CCFs** with the CRR regulatory values [4]. For this purpose, the ECB considers that institutions should implement:

- A data collection process enabling the calculation of realised LGDs and CCFs, as well as the performance comparison with the CRR [4], ensuring that it is not distorted by an excessive representation of cured cases or high recoveries;
- An internal reporting process detailing the outcomes and conclusions of these comparisons, broken down by rating system.

Institutions applying the IRB approach for a given exposure class or type may be authorised to **revert to the Standardised Approach (SA) or to the Foundation IRB (F-IRB) for LGD and CCF**. To this end, institutions are required to document the rationale for reverting to a less sophisticated approach and to formalise objective and consistent criteria for selecting the approach to be applied to all IRB exposures within the same class or exposure type. Furthermore, institutions should apply the IRB approach consistently across all exposure classes and/or types that exhibit similar modelling characteristics.
Where the reversion results in a non-negligible reduction in capital requirements, institutions should provide convincing evidence that it is not meant to lower own funds requirements, considering:

- The required operational capability and cost to maintain a rating system for the respective exposure class and/or exposure type;
- The availability of sufficient representative data for the development or redevelopment of a model, or for the development of another eligible approach;
- The feasibility of using another available IRB approach;
- The impact of the reversion on own funds requirements by comparing the capital requirements generated under the currently applied approach with those resulting from the use of the less sophisticated approach (SA or F-IRB).

Internal Governance

Institutions are required to assess and report the **materiality of their rating systems** to the competent authority. This assessment must be reviewed regularly, as it may be affected by internal or external factors.
In terms of **decision-making responsibilities**, the material aspects of rating and estimation processes must be approved by both the management body and senior management, with documentation that can be made available for review upon request by the institution's internal audit function or the competent authority. Institutions should clearly define which policies require approval at both governance levels and ensure that this is explicitly reflected in the respective mandates. At a minimum, dual approval is required for:

- Risk management policies that may have a material impact on the institution's rating systems and risk estimates;

Main Changes
The 2025 version of the ECB Guides to Internal Models introduced the following requirements in relation to the **application of the Internal Rating-Based (IRB) approach:** • Institutions adopting the IRB approach for one exposure class are **no longer required to extend it to all non-trading book exposures;** • Institutions adopting the IRB approach for one exposure class are required to apply it **consistently within an exposures class,** while the **Standardised Approach (SA)** might be implemented for **immaterial exposures;** • In determining the **appropriate capital requirements calculation approach, documentation and agreement of criteria with the competent authority is now only required;** • In determining the appropriate capital requirements calculation approach, institutions are now required to also take into account the **availability of minimum representative data** for the development of a rating system; • Institutions adopting the IRB approach are required to implement **a group-wide internal models strategy,** objective criteria for choosing approaches (costs, scale, data availability) in dialogue with supervisors. The 2025 issue of the ECB Guides to Internal Models introduced the following requirements in relation to the **governance of the roll-out plan for the IRB approach:** • As for reporting of the status of the roll-out plan, institutions are now **expected to also cover the exposure classes for which the future use of the IRB approach is envisaged.** The 2025 issue of the ECB Guides to Internal Models introduced the following requirements in relation to the **monitoring of compliance with permanent partial use provisions and less sophisticated approaches:** • Institutions implementing the F-IRB approach are now required to **collect and retain data to compare realized LGDs and CCFs with the CRR regulatory values.**

TABLE 6: Main updates related to application, rollout and permanent parital use of the IRB approach.

Main Changes
The 2025 version of the ECB Guides to Internal Models introduces explicit requirements for the **management body and senior management in terms of responsibility for the quality, completeness, and timeliness of the submission and implementation of new models, as well as model changes or extensions.** Addition, in line with paragraph 79 of the EBA Supervisory Handbook on Validation, the ECB now expects that an institution submits applications for approval of new models, model changes, or model extensions **only once all necessary remediation actions addressing any deficiencies in the rating system have been completed.**

TABLE 7: Main updates related to internal governance.

- Policies addressing the risk associated with the operational disruption of a third-party provider responsible for model-related tasks.

Senior management must inform the management body of any material changes to, or deviations from, the established policies. This must be done using defined quantitative and/or qualitative criteria and documenting any expert judgement applied. Additionally, **both the management body and the senior management are responsible for the quality, completeness, and timeliness** (i.e. adherence to agreed timelines) **of the submission and implementation of new models, as well as model changes or extensions**. In particular, the ECB now [3] expects that sufficient time is dedicated to the independent assessment for identifying and evaluating any deficiencies in the rating system as well as that institutions submit applications for approval of new models, model changes, or model extensions **only once all necessary remediation actions addressing any deficiencies in the rating system have been completed**. As for **management reporting**, to ensure consistent oversight of the functioning of rating systems, institutions must define the level of detail, content, and frequency of the reports provided to senior management and the management body, in proportion to the materiality of the rating systems.

Regarding the **understanding of the rating**

systems, institutions must ensure that:

- The management body possesses a general understanding of the rating systems;
- Senior management has a thorough understanding of the design and functioning of the rating systems.

Regarding the **Credit Risk Control Unit (CRCU)**, institutions must ensure its independence from the staff and management functions responsible for the origination and renewal of exposures, clearly identifying:

- The components and scope of the credit risk control function;
- The units and staff responsible for origination/renewal;
- The rationale supporting their mutual independence.

In addition, institutions must ensure that the CRCU has a clear written mandate specifying its roles and responsibilities and a direct reporting line to senior management.
Finally, institutions must ensure that **risk estimates are reviewed** whenever new information becomes available and, in any case, at least annually. The ECB considers it best practice to carry out such review on the basis of:

- Ongoing monitoring performed by the CRCU;
- Annual validation of internal estimates conducted by the validation function.

Internal Validation

The ECB applies the *EBA Supervisory Handbook on Validation [1]* as its interpretative guide for assessing validation practices under the IRB approach.
Validation must ensure that ratings differentiate risk and use appropriate credit risk parameters and it should be performed at all levels where rating systems are approved, while responsibility remains with the level of formal approval. Additionally, institutions are now required to ensure traceability and reconciliation between local validation outcomes and group-level reporting, to **strengthen the overall consistency of internal validation outcomes**.
In terms of **scope and frequency of the validation function**, institutions must implement a structured validation framework (Article 185 CRR [4]), inclusive of policies and methods to assess accuracy, robustness and stability of risk parameter estimates. In so doing, Validation verifications must combine both qualitative and quantitative analyses (i.e., ranking power, calibration, representativeness, overrides, stability, model specification, input data quality, benchmarking, data cleansing) as well as the **setting and, in case, reviewing of thresholds triggering investigations and remedial actions, which must be clearly defined with governance mechanisms**.
Initial validation, annual assessments, and full validations for material systems at least once every three years are expected.
Additionally, **material model changes require full revalidation** and **stronger expectations around the timeliness and documentation of validations following such changes** are now envisaged.
Analyses must be performed independently by the validation function with access to all relevant data and the results should be documented in a **validation report** structured in a way that allows **auditability and challenge** by both **internal audit** and **supervisory authorities**.
For non-material systems, the validation function may rely on back-testing and analyses performed by the CRCU, while ensuring that independence and oversight remain appropriate.
As for **reporting**, Institutions must inform senior management and committees of conclusions, recommendations and deficiencies in aggregated form to allow proper assessment, and implement remedial measures

Main Changes
In the 2025 version of the ECB Guides to Internal Models, the alignment with the EBA Supervisory Handbook on Validation has been further strengthened, with additional clarification on the expectations for validation structure, independence, and reporting. In particular: • Institutions must ensure traceability and reconciliation between local validation outcomes and group-level reporting, to **strengthen the overall consistency of internal validation outcomes;** • Institutions should establish **clearly defined governance mechanisms for the setting and periodic review of thresholds** determining control outcomes, ensuring explicit link to the institution's risk appetite and materiality framework; • **Material model changes now require full revalidation,** introducing **stronger expectations around the timeliness and documentation of validations following such changes;** • For **non-material systems**, the **validation function may rely on back-testing and analyses** performed by the CRCU; • **Validation reports** should be structured to allow **auditability and challenge** by both **internal audit and supervisory authorities;** • **Remediation plans** should include **clearly defined timelines, responsible owners, and escalation mechanisms for delays or implementation failures;** • **Senior management involvement in decision-making should be documented and traceable in internal governance records;** • Institutions are expected to maintain a **record of historical validation methodology changes** and make it **available to supervisors** upon request.

TABLE 8: Main updates related to internal validation.

(model changes, recalibrations) with status tracking. **Remediation plans**, in particular, must include **clearly defined timelines, responsible owners, and escalation mechanisms for delays or failures in implementation**.

For material rating systems, senior management should be directly involved in decision-making and such **involvement must be documented and traceable in internal governance records. Moreover**, any **significant changes to validation methodologies or processes must be communicated to the competent authority**, maintaining a **record of historical validation methodology changes** to be made **available to supervisors** upon request.

Internal Audit

Institutions must have an independent audit function to review their rating systems and related operations regularly, ensuring compliance and reliability. In so doing, audits must follow a risk-based approach: High-risk areas are subject to more frequent in-depth reviews, while others are reviewed at least once every three years.

In terms of **scope**, Internal Audit is responsible for assessing rating systems development, performance and use (in risk management, credit decisions, capital allocation and governance) on top of regulatory capital calculations, as well as **reviewing data quality, rating assignment integrity, validation independence and effectiveness**. Additionally, Internal Audit assessments must also cover newly introduced areas, such as the **governance of machine learning techniques**, including explainability, data handling, and the justification for model complexity where applicable.

All Internal Audit procedures and findings must be documented and approved by the management body.

In the context of initial IRB applications or extensions, it is considered a good practice for Internal Audit to perform an independent pre-assessment to verify compliance and completeness.

Furthermore, material changes to rating systems or validation methodologies must also be independently reviewed by Internal Audit. In particular, institutions are expected to also include clearly **defined roles and**

responsibilities across control functions (including Internal Audit, model risk management, and IT) for aspects such as default definitions, exposure classifications, and technical implementations, in the context of material changes to rating systems or validation methodologies.

Model Use

For **initial approval** to adopt the IRB approach or internal LGD/CCF estimates, institutions must show at least three years of compliant use of rating systems in risk management, credit approval, and decision-making, in line with CRR rules [4].

When **extending the IRB approach** to new entities or exposures, specific proof of compliance is required if these exposures differ significantly from those already covered (Article 145(3) CRR [4]). If they are not significantly different, consolidated experience may suffice, though individual-level evidence is still needed.

As for **risk management, credit approval and decision-making process**, the CRR [4] mandates that internal ratings and default/loss estimates generated by rating systems must be central to risk management, business decisions, and credit approval. The ECB considers these practices compliant when internal ratings and estimates are fully integrated into credit approval procedures and policies, calibrated according to rating classes or risk parameters.

Key application areas include transaction pricing, Early Warning Systems, recovery and collection, credit risk adjustments, and allocation/delegation in approval.

Internal ratings and default/loss estimates are central to **institutions' corporate governance functions**. To ensure their effective use, they should be embedded in management reporting and portfolio credit risk monitoring within internal policies.

Ongoing **portfolio monitoring** by the CRCU involves descriptive analyses of portfolio risk, exposure distribution across rating classes, average risk estimates and realizations, and expected losses (EL), progressively enriched with analytical insights from ratings. Reporting to senior management is intended to deliver a concise yet comprehensive overview, enabling effective monitoring of credit risk developments at the portfolio level.

As for **human judgement**, institutions must document and regulate overrides (i.e., cases where human judgement modifies inputs or outputs), ensuring they only address relevant information not captured by standard risk drivers and are properly assigned to responsible personnel. Any such deviations must be governed by internal policies. Model results should be complemented by expert judgement when additional relevant information is available, though reliance on statistical outputs increases with larger datasets.

As for **non-rated exposures or outdated ratings**, institutions must review each exposure at least annually and investigate, as these may pose compliance risks according to the CRR [4]. Institutions must establish policies for the non-rated exposure and outdated ratings identification and monitoring, with annual validation checks. Ratings not updated within 12 months may benefit from a three-month transitional period, during which monitoring, reporting, escalation, and credit restrictions apply; afterwards, conservative measures must be enforced.

All IRB exposures must be classified and cannot shift to the Standardised Approach without authorisation. To prevent capital requirement underestimation, institutions should adopt prudent practices, such as temporarily downgrading non-rated ratings and assigning the lowest class to unclassified exposures, subject to annual validation.

Institutions must document and justify any human **overrides** of rating system outputs, distinguishing them from policy deviations, with stricter conditions for positive overrides. Overrides must be recorded with both qualitative and quantitative details,

Main Changes
In the 2025 version of the ECB Guides to Internal Models: • The **scope of Internal Audit responsibilities** has been further aligned with the EBA Supervisory Handbook on Validation, to provide a more structured review of **data quality**, the **integrity of the rating assignment process**, and the **independence and effectiveness of validation processes**; • Internal Audit assessments must also cover newly introduced areas such as the **governance of machine learning techniques;** • Reviews are expected to also include clearly **defined roles and responsibilities across control functions** in the context of material changes to rating systems or validation methodologies.

TABLE 9: Main updates related to internal audit.

and policies should limit their scope.
Finally, institutions must analyse the performance of overridden exposures to detect weaknesses, applying corrective measures when necessary. If overrides do not improve accuracy, policies must be reviewed and strengthened, ensuring consistent application and consideration of economic interdependencies.

Management of Changes to the IRB Approach

Any changes to rating systems or their scope require either supervisory approval if material or notification if non-material. Therefore, institutions must adopt a formal **change policy** with clear criteria to ensure consistent classifications and to avoid regulatory arbitrage.
Moreover, institutions must ensure **classifications** are consistent and non-arbitrary: Material changes cannot be split to appear non-material, unrelated changes cannot be combined to reduce materiality, and in cases of doubt the highest level must be assigned, confirmed by independent review.
Impact assessments must include both quantitative (i.e., calculate before/after effects on RWEAs using recent data for the full portfolio or a representative sample) and qualitative (i.e., review regulatory criteria and document conclusions) analysis.
Finally, when a material change is approved, it must be applied from the specified date, with immediate **re-rating** where feasible, or otherwise within 12 months, supported by temporary upward RWEA adjustments. For non-material changes, re-rating may also take up to one year.

Data Maintenance for the IRB Approach

Institutions using the IRB approach are required to maintain robust, well-documented, and thoroughly tested IT systems, supported by sound data management practices.
Firstly, in terms of **IT infrastructure and implementation**, institutions must ensure that all systems supporting the IRB models are stable, transparent, and well-maintained.
When implementing a new model or making material changes to existing ones, institutions must demonstrate that the model has been fully integrated into a live production environment.
Institutions must also carry out comprehensive testing of their IT implementations. This involves a clearly defined, organisation-wide testing policy covering various testing types — such as unit, integration, system, user acceptance, and regression testing — triggered by events like software updates, regulatory changes, or model methodology revisions.
Secondly, regarding **data processing and governance**, institutions must establish group-level policies for managing data throughout its lifecycle — from collection to use. These policies must ensure that data transformations are traceable and controlled, and that responsibilities are clearly assigned.
Finally, institutions must implement a

comprehensive **data quality management framework** that applies to all IRB-relevant data, including internal, external, and pooled sources. This framework should be underpinned by strong governance and must be approved by the management body or a delegated committee. It should be distributed to relevant staff, regularly reviewed and updated, and independently audited. A dedicated, independent unit should oversee data quality management.
In case of data quality issues, institutions must have a structured remediation process, inclusive of independent assessments, prioritised recommendations, clearly assigned responsibilities, and action plans with deadlines based on the severity of the issue. Importantly, any remediation should address the issue at its source.
Finally, institutions must report regularly — more frequently than annually — on data quality to the management body or a designated committee. These reports must be standardised, provide a clear overview of data quality performance, include findings and recommendations, and demonstrate that appropriate corrective actions have been taken.

Definition of Default

Consistency of the Application

A default occurs when either of the following applies (Article 178(1) CRR [4]):

- The institution considers the obligor **unlikely to repay** without recourse to collateral ("unlikeliness to pay");
- The obligor is over 90 days **past due** on a material credit obligation (i.e., exceeding €100 for retail or €500 for non-retail exposures, and representing more than 1% of total on-balance sheet exposures to the obligor).

The **definition must be applied consistently** across groups, with limited exceptions for immaterial cross-entity exposures. Institutions must also ensure consistent treatment of joint obligations, check thresholds in different jurisdictions where relevant, and count defaults per obligor while controlling correlation effects in PD estimates.

Days Past Due Criterion

The **past-due days criterion** applies to all exposures and defines default when any amount remains unpaid for more than 90 consecutive days beyond the materiality threshold. From that point, all affected exposures must be classified as default without undue delay. The ECB clarifies that alternative approaches (such as those based on "months in arrears") are not acceptable, and that the reference standard must always be the 90-day rule. The EGIM provides detailed specifications regarding:

- **The level of application for counting days past due (borrower level vs. single exposure)**;
- **The conditions for resetting the count to zero days past due**;
- **The definition and treatment of technical defaults**;
- **Specific treatment for exposures to public entities, factoring, and purchased receivables**.

Unlikeliness to Pay Criterion

The **unlikeliness to pay** criterion is intended to identify debtors who are unable or unwilling to meet their obligations.
In the case of **sales of credit obligations**, institutions must assess the reasons for the sale and any losses incurred. Where sales are linked to credit risk, the materiality of the loss must be determined without adjustments to the sale price, and transactions such as securitisations with significant risk transfer are also considered within this scope.
For **distressed restructurings**, the analysis is based on a comparison between the

present value of the original cash flows and that of the restructured cash flows, both calculated using the original effective interest rate.
This calculation must be performed for all restructurings at the moment of their conclusion, regardless of whether the reduction in the financial obligation clearly exceeds the threshold.
Any concession granted to a debtor already in default must be treated as a distressed restructuring. In addition, institutions are required to establish further indicators of unlikeliness to pay beyond those explicitly listed in the regulation, adapting them to the characteristics of the exposures.
Finally, institutions must also take into account **external information**, ensuring that it is updated and monitored with sufficient frequency to allow timely identification of default. The intensity of this monitoring may vary across client categories, provided it remains adequate to the risk profile.

Return to Non-defaulted Status

The conditions for the **return to non-default status** require that exposures remain under observation for a defined probation period, which is generally longer for exposures subject to distressed restructuring.
Where default is applied at borrower level, reclassification may occur only when all of the debtor's exposures meet the necessary requirements. Where default is applied at the level of a single exposure, each position can return to non-default separately.
The conditions for reclassification differ depending on whether the exposure has been subject to **distressed restructuring**:

- Without restructuring: An exposure may return to non-default even if some past-due amounts remain, provided they are not significant and do not exceed the 90-day threshold, and all other requirements are met.
- With restructuring: There must be no arrears of any kind under the new repayment plan. On top, one of the minimum conditions for reclassification is that the debtor makes a material payment during the probation period. The ECB stresses that institutions must carefully define and monitor the concept of "material payment" to ensure that their policies for return to non-default are effective.

The activation of new default triggers during the **probation period** affects its duration. For exposures without restructuring, the minimum period is three months from the cessation of all triggers, and the count restarts if new triggers arise. For exposures with restructuring, the minimum period is one year, again restarting if new triggers are activated.

Consistency of External Data

When institutions use **external data** for risk quantification that are not aligned with the internal definition of default, they must ensure equivalence through appropriate adjustments.
The ECB also highlights that the use of external data generally increases estimation uncertainty. As a consequence, a Margin of Conservatism (MoC) should be applied to cover this additional risk.
For the development of rating models, the use of reference data based on a different definition may still be accepted, provided that institutions can demonstrate that model structure and performance are not compromised and that the model continues to ensure both adequate risk differentiation and predictive capacity in line with the internal definition.

Adjustments to Risk Estimates in the Case of Changes to the Definition of Default

A **change to the definition of default** requires prior approval from the competent authority and should be implemented consistently across portfolios to avoid misalignments.

Following such a change, institutions must demonstrate that their models preserve an adequate ability to **differentiate risk**, based on updated historical data. If this ability is not ensured, a simple recalibration is not sufficient and models must be redefined or redeveloped.
To guarantee the **representativeness of historical data**, institutions must adapt them to the new definition. When adjustments do not fully cover the historical period, missing information may be complemented with simplified assumptions, provided they are based on sufficiently robust evidence.
In all cases, institutions are required to **apply a Margin of Conservatism (MoC)** to cover the additional estimation uncertainty that arises from the change. This applies not only when adjustments are necessary, but also when the estimated impact of the new definition appears negligible. Only when historical data already fully reflect the new definition, without the need for corrections or assumptions, can the Margin of Conservatism be reduced to zero, as no additional uncertainty is deemed to exist beyond the general model error.

Estimation of Credit Risk Parameters

Use of Data

Institutions must ensure that **data used for credit risk measurement** are high-quality, representative, and reliable for PD, LGD, and CCF estimation. CRR rules [4] apply equally to internal, external, and pooled data; thus, while external data may complement internal shortages, they must be representative, carefully validated, and free from double-counting, with conservatism applied where deficiencies exist. Institutions must also understand data sources and processing, document clearly internal vs external data, and remain fully responsible for model performance.
External ratings or scores must be updated, validated, and balanced with internal information, avoiding bias and correlation. When pooling or using vendor models, rating systems and criteria must be comparable, calibration must rely on internal data, and consistency across institutions must be ensured. Any adjustments to outputs should trigger analysis of model weaknesses.
Moreover, **human judgement** in model development must be limited, controlled, and supported by a formal framework, with additional conservatism when data are scarce. After mergers or acquisitions, combined histories must be used, workout differences addressed, and, if acquired data are weak or inaccessible, deficiencies compensated with conservatism.

Probability of Default

PD models must rely on relevant risk drivers, avoid overfitting, be validated on independent datasets, and be regularly reviewed for discriminatory power. They must ensure consistent risk differentiation across material sub-segments, with each exposure unambiguously assigned to a single, well-documented model.
In terms of **risk differentiation**, rating systems must ensure meaningful and stable risk differentiation over time, with clear separation across grades or pools and homogeneity within them. avoiding excessive concentration or very small groups without empirical support. while overlaps between grades must be minimized and differentiation demonstrated in observed default rates.
Obligors must be assigned to a grade at approval, with clear policies on when third-party ratings or support affect assessments.
As for **risk quantification**, PDs must be estimated from one-year default rate LRAs by grade for corporates, banks, sovereigns, and equity, and by grade or pool for retail. The computation of one-year default rate must follow the requirements of the EBA Guidelines.

Main Changes
The regulatory update introduced several important changes in the calibration of the LRA default rate. First, it is now made explicit that the first step is to verify whether the historical observation period is representative of the "**likely range of variability**" of default rates. If it is, the LRA default rate must be calculated as the observed average in that period. Adjustments must therefore clearly be applied only **after** this type of assessment. Regarding the **assessment of representativeness**, the updated is-sue of the ECB Guides to Internal Models is much more extensive and prescriptive: It explicitly requires the inclusion of at least the **five most recent years** and, where relevant, **additional years** as a continuous time span. The previous version, by contrast, mentioned the need to assess the historical window but did note stablish an explicit minimum requirement. In addition, the updated issue requires **correlation analysis** between internal DRs and economic indicators, while in the previous institutions were also required to consider relevant economic indicators in assessing representativeness, but no clear operational process was formalised and the choice remained more discretionary. Finally, the requirement to assess the proportion of **bad years** over a typical 20-year horizon and to verify the inclusion of the maximum/minimum observed one-year DR are new elements that were not previously envisaged. The most recent ECB Guides to Internal Models version also establishes, as a best practice, a **reference period** (Jan 2008 – Dec2018, with observation until Dec 2019) to be used for comparison with the institution's LRA DR (before MoC). If the internal LRAis **lower** than the reference, the bank must either **justify** it or revise the LRA; the reference is a **benchmark** but not a strict floor. Finally, with regard to the operational role of correlation be-tween DRs and economic indicators, the updated ECB Guides to Internal Models version distinguishes two paths: (i) If no significant correlation is found, the analysis of **internal variability** (including max/min) becomes crucial; (ii) If correlation exists, institutions are required to define **bad/good** years, calculate the proportion of bad years over 20 years, and verify that the chosen window includes at least that proportion. This level of operational detail was absent in the previous version of the ECB Guides to Internal Models.

TABLE 10: Main updates related to probability of default.

To calculate the LRA default rate, institutions should follow paragraphs 82–86 of the EBA Guidelines on PD and LGD.
If the historical observation period is representative of the **likely range of default rate variability**, the LRA default rate is the observed average default rate in that period (paragraph 84). If the period is not representative, adjustments to the observed average default rates must be made (paragraph 85) using external default rates or, if unavailable, other relevant observed indicators for the exposure type. To assess whether the historical observation period is **representative** of the likely variability of one-year default rates (paragraphs 82–83 of the EBA Guidelines on PD and LGD), institutions should follow these principles:

1. **Length of period:**
    - Include at least the **five most recent years** at model calibration.
    - **Add earlier years** if relevant to capture the full variability, ensuring a continuous time series without breaks.
2. **Variability and economic relevance**:
    - Select economic indicators relevant to the exposure type (geography, sector, other risk drivers).
    - Analyse correlations between internal default rates and these indicators over the longest common time period, considering potential time lags.
    - If the internal series is too short for meaningful correlation, the period is not representative, and adjustments per paragraph 85 of the EBA Guidelines should be applied.
3. **No significant correlation**:
    - If correlations with economic indicators are not statistically significant, focus on **observed default rate variability**.

- The period should typically include at least the maximum and minimum observed one-year default rates.

4. **Significant correlation**:
   - Define and document criteria for classifying years as **"good" or "bad"** based on the economic indicators. Bad years must reflect actual adverse conditions.
   - Compute a reference proportion of bad years using a long enough time window (typically 20 years) including sufficiently severe indicator values; extend the window if necessary.
   - Ensure the historical period contains at least the same proportion of **bad years** as the reference.
   - Verify that the maximum observed one-year default rate is included; if not, provide documented justification.
5. **Scarce internal data:**
   - If limited internal exposures or defaults make variability analysis unreliable, consider using external or pooled default rate series.
   - These external series must be relevant to the portfolio in terms of geography, sector, and other risk drivers.

This approach ensures that the historical observation period adequately captures the likely range of default rate variability for PD estimation.
Institutions should compare the calibration-segment LRA default rate (pre-MoC) with a reference LRA default rate:

1. **Reference period**:
   - Compute the reference LRA DR over a fixed period, typically January 2008 to December 2018 (observation period until December 2019).
   - If internal data for the full period are unavailable, supplement with inferred/extrapolated internal DRs or relevant external default rates, applying necessary adjustments.
2. **Comparison and justification:**
   - If the LRA DR is below the reference LRA DR, institutions must **justify** why their chosen period better reflects the likely variability, or revise the LRA DR.
   - Any adjustments applied to address data deficiencies (per paragraph 38 of the EBA Guidelines) should be included in the LRA DR used for comparison, with similar adjustments applied to the reference period if relevant.

The reference LRA DR serves as a **benchmark** to assess the appropriateness of the institution's chosen historical observation period and LRA DR quantification, but it is not a floor. It complements the principles of this chapter and paragraphs 82–86 of the EBA Guidelines on PD and LGD, which must be followed regardless of the reference LRA DR results. When paragraph 86 of the EBA Guidelines applies, the reference LRA DR acts as a supplementary comparison against the institution's adjusted LRA DR.
For calibration to the LRA default rate, institutions should follow paragraphs 87–99 of the EBA Guidelines on PD and LGD.
PD calibration must be documented and ensure adequacy, risk differentiation, and discriminatory power at both grade/pool and segment levels. LRA default rates require long time series; if data are limited, adjust for good/bad years with MoC. Grade-level PDs (92(a)) should match LRA rates, with segment-level checks; segment-level calibration (92(b)) must avoid bias or loss of discriminatory power. Overrides must

be reflected or adjusted with MoC, and all deviations analysed and documented.
Mapping internal to external grades using observed default rates must be consistent, predictive, and bias-free, with documented rating differences, representativeness checks, adjustments for non-default factors, and MoC for withdrawn ratings.
Direct PD estimates must ensure strong risk differentiation, proper calibration, comonotonicity with scores, sufficient observations, and adequately narrow, populated grade sub-ranges for meaningful LRA default rates. When mapping to a master-scale, PDs must not systematically or materially underestimate risk at portfolio or grade level.

Realised LGD

Institutions must base LGD estimates primarily on their own historical default and recovery data, but it's also possible to use external sources. In case of limited representativeness of external data, a category A MoC should be considered, in order to reflect the uncertainty of the estimation. Also market prices of defaulted instruments could be used, but institutions must ensure the sample is representative of their portfolio in terms of geography and product type, and must adjust market-based losses upward to include indirect costs.
Regarding the computation of the realized LGD, that should be do at facility level, the following themes are specified:

- What should be taken into account for the economic loss computation;
- Treatment of multiple default;
- Treatment of Massive Disposals (Art. 500 of the CRR [4]).

In terms of **risk differentiation**, the LGD should be estimated in compliance with the aspects reported below:

- Requirements for the use of internal statistical models.
  - Use material risk driver and ensure risk differentiation across grades/pools.
  - Testing Model Performance on independent datasets (both out-of-time and out-of-sample).
  - Continuous monitoring of the model.
- Requirements for the direct estimation models.
- Ensure the mitigation of losing discriminative power in models based on several model components.

In terms of **risk quantification**, Institutions must calculate the observed average LGD over the full data history, regardless of the estimation approach. Defaults close in time to the estimation must be included, though a minimum observation period — no longer than twelve months. All relevant information from shorter observations should still be considered.
More in detail, institutions should take into account the following principles in order to correctly compute the Observed Average LGD:

- Define a time-to-work-out in order to avoid any bias due to long recovery processes;
- Infer the recovery for Incomplete Recovery Process in a prudent manner;
- Correctly adjust the collateral value for Repossessed but Unsold Collateral and compare with past repossession and sale data.

Then it's set out the principles on how the LRA LGD should be computed and at which level, specifying with data should be used and the conditions required in case external data have been used. In addition further detail on the calibration of LGD estimates to the LRA LGD are given:

- Definition of the calibration level;
- When calibrate LGD based on model components.

Main Changes
The ECB clarifies how institutions should approach the calibration of downturn LGD. First, downturn LGD must always be calibrated at the **same level of granularity** as the long-run average LGD (LRA LGD), and not at a more aggregated level, to ensure consistency between normal and stressed estimates. When calibration is based on observed impact, banks should carefully assess how downturn periods affect losses across **all relevant dimensions**, the four pillars described in the EBA Guide-lines for downturn estimation. If the model relies on multiple LGD components, each one should be analysed separately, with particular focus on the component that shows the **strongest down-turn effect**. Other components should also be included, when necessary, as long as the aggregation method is well justified. The ECB stresses that downturn LGD estimates must at least capture the higher average realised LGDs seen in downturn years, even if the data period does not perfectly overlap with the identified downturn. In addition, institutions are required to calculate a **reference value** to benchmark their downturn LGD estimates. This is done in two steps: identifying the **two years with the highest observed economic losses** and then computing the **simple average of the average realised LGDs** in those years. Both completed and incomplete recovery processes must be included in this calculation, consistent with the LRA methodology. The comparison between downturn LGD and the reference value must be performed at least at **calibration segment level**, though further checks at grade or pool level are encouraged if sufficient data are available. Where continuous estimates are used, the downturn LGD should be expressed as a **default-weighted average** of the exposures defaulting in the two worst years. The ECB expects institutions to investigate carefully whenever the reference value is **materially higher** than their downturn LGD estimates (before adding a margin of conservatism). Such differences are not automatically evidence of an unidentified downturn period. They may simply arise if the two years selected overlap with the downturn already identified by the institution, or if losses in those years were unusually high due to idiosyncratic factors rather than general economic stress. In such cases, banks must provide strong justification. However, if the difference can-not be explained by these reasons, institutions must **reconsider whether their downturn identification or LGD quantification is sufficient**. Special scrutiny is required where the reference value is not only higher than the downturn LGD but also higher than the downturn LGD plus the final margin of conservatism, as this suggests a higher risk of underestimating downturn effects.

TABLE 11: Main updates related to realised LGD.

Moreover, Institutions should estimate also the LGD under downturn conditions as specified in the EBA Guidelines on downturn LGD.

Downturn LGDs cannot be calibrated at a **higher aggregation level** than LRA LGDs, ensuring consistency between normal and stressed conditions. When downturn LGDs are based on observed impact, institutions must assess the downturn effect across **all the four pillars**. If multiple LGD components are used, the analysis should cover each one, and the highest impact of the impact in terms of final downturn LGD should be considered. Final estimates must at least capture the elevated average LGDs of all defaults in a given year, even if this does not match exactly the downturn period, to reflect the **broader effect** of adverse conditions.

Institutions must compute a **reference value** in two steps:

1. Identify the **two years with the highest economic loss**, based on the ratio of total loss to outstanding exposure, including both closed and incomplete recoveries treated consistently with LRA LGD;
2. Calculate a **default-weighted average LGD** for each year, then take the simple average.

The final downturn LGD must be compared with this reference at least by **calibration segment**, though further analysis may be needed at grade or pool level if discrepancies persist. For continuous estimates, The institution should calculate the final downturn LGD for each LGD range (or calibration segment) as the **default-weighted average** of the final LGD estimates of all defaulted exposures in the RDS within that range, provided the defaults occurred during the two selected years.

Institutions must investigate cases where the reference value is **materially higher** than the downturn LGD (before MoC).

Such differences are not evidence of unidentified downturns if:

1. The two years overlap with identified downturn periods, or
2. The years were not economically adverse and losses were idiosyncratic, with justification provided.

In all other cases, institutions must **reassess their downturn LGD quantification** and adjust if necessary, especially when the reference value also exceeds the downturn LGD plus MoC, where underestimation risk is highest.
For exposures already in default, institutions must calculate the sum of the Expected Loss Best Estimate (ELBE), reflecting current economic circumstances and exposure status, plus an estimate of additional unexpected losses during the recovery period. ELBE should reflect the best estimate of expected loss given current economic circumstances and exposure status. Downturn effects are included only if current economic conditions are in a downturn or a downturn is expected over the period of the recovery process. This may be done by incorporating macroeconomic drivers into the ELBE model. LGD in-default may be estimated directly or as ELBE plus an add-on for unexpected losses related to the exposures in default that may occur during the recovery period.

Conversion Factors

Institutions must apply **IRB-CCFs** to retail exposures (Art. 151(7) CRR [4]) and, if authorised, also to corporates, sovereigns, banks, and public sector entities (Art. 151(9) CRR [4]). The scope of IRB-CCF modelling is limited to undrawn revolving commitments, provided they are not subject to a **100% SA-CCF** under the Standardised Approach.
When IRB-CCFs are used, exposure values are subject to a **CCF input floor** (Art. 166(8c) CRR [4]). Other off-balance-sheet items, such as undrawn non-revolving commitments, must follow the SA-CCF rules (Arts. 166(8) and 166(8a) CRR [4]). A CCF is defined as the proportion of undrawn **commitments** that may become outstanding at default. For revolving facilities, exposure equals the undrawn amount multiplied by the IRB-CCF.
According with **Article 166(8)**, institutions must treat facilities as exposures from the moment they are available for drawings, taking into account advised and unadvised limits, commitments defined under CRR [4], and whether facilities are revolving.
Where IRB approval is not granted, **SA-CCFs** must be applied for corporates, sovereigns, and public sector entities. This ensures consistency in calculating risk-weighted exposure amounts (RWEA).
In terms of calculation, institutions must apply clear policies to ensure consistent realised CCFs, including all obligations (e.g., interest, fees, overdrawings). In particular, to comply with Articles 176(4) and 182(1d) CRR [4], RDS should not be limited to the principal outstanding of a facility or the available facility limit, but must also capture all credit obligations, including accrued interest, fees, and drawings in excess of facility limits.
The CCF is generally calculated at the facility level, even if some aggregations consistent with LGD are allowed.
Realised CCF is measured as the ratio of the difference between the drawn amount at default date and the drawn amount at the reference date in the numerator, and the difference between the limit at the reference date and the drawn amount at the reference date (i.e., the committed but undrawn amount at the reference date) in the denominator.
Discounted drawings are included if also considered in LGD, and in cases of multiple defaults on the same facility, only the first default date is used.
Institutions must assess how changes in customer product mix affect exposure reference datasets and IRB-CCF estimates, and

Main Changes
With the new issue of the ECB Guides to Internal Models, a first significant change concerns the scope of application of **IRB-CCFs**, which is now limited to undrawn revolving commitments, provided they are not subject to a **100% SA-CCF**. Moreover, the updated issue of the ECB Guides to Internal Models introduces the concept of a "**CCF input floor**", which was not addressed in the previous version. Specifically, a CCF input floor represents the minimum regulatory value applied to IRB CCFs to ensure that exposure at default (EAD) estimates do not fall below a prescribed value. Furthermore, the new guidelines explicitly refer to Article 5(10)of the CRR to identify all arrangements that qualify as **commitments, and to Article 166(8b)** to define revolving commitments. Previously, there was greater granularity in the definition of commitments (general commitments, conditionally cancellable commitments, credit lines), which, however, were not precisely defined within the regulation. Now, explicit reference is made to the articles mentioned above, so the possibility to have different interpretation is reduced. An additional aspect is that, unlike under the previous issue of the ECB Guides to Internal Models, it is no longer possible to apply IRB-CCFs of 0%. In cases where an institution does not have internal models, **SA-CCFs** must instead be applied. The EGIM further specifies that the calculation of **realised CCFs** is based on the drawn amount at the default date, rather than the EAD, while the denominator now refers to the committed but undrawn amount instead of the broader amount available to be drawn. This change makes the calculation of the realised CCF more aligned with effective data, as it focuses on the drawn amount rather than on an aggregated estimate such as the EAD. In addition, unlike the 2024 version of the ECB Guides to Internal Models, the **reference date** for analysing risk drivers is now fixed exactly at 12 months prior to default, rather than up to 12 months before, thereby reducing temporal flexibility. The EGIM also establishes that **negative CCF** values must be treated in accordance with Article 182(1)(a). In the previous version, negative values were not addressed, since the focus was on extremely high values. Finally, Unlike the 2024 issue of the ECB Guides to Internal Models, the current version explicitly introduces a regulatory reference for the requirement under Article 182(1)(c), namely that IRB-CCF estimates must be quarantined from potential distortions arising from the "**region of instability**". Although this topic was already discussed in the previous version of the guidelines, the 2025 issue of the ECB Guides to Internal Models formalize sit as a regulatory obligation.

TABLE 12: Main updates related to conversion factors.

demonstrate that any impact is immaterial or mitigated in their estimation process. Since product profile transformations (e.g., revolving commitments turning into term loans) can distort CCF models, institutions must address these effects in line with Article 182(1b) CRR [4].

The **reference date** for realised CCF is 12 months before default, and models must reflect current account and limit monitoring policies. Statistical models used to assign exposures must be validated with independent data to avoid overfitting and must be monitored.

As for **CCF quantification**, for institutions using IRB-CCFs, exposure for undrawn commitments is calculated as the undrawn amount multiplied by the IRB-CCF, which can also be derived from direct estimates.

Realised CCFs should be calculated at a granular level, ensuring no systematic deviations between estimated and realised values. Default-weighted average CCFs are computed separately for each facility grade or pool.

Over the observation period, observed average CCF for each facility grade or pool are calculated on all defaults observed and, for this purpose, institutions must treat **negative realised CCFs** as laid down in subparagraph one of Article 182(1)(a) of the CRR [4]. CCF values above 100% should be analyzed, not capped; economic downturns and near-full utilization must be considered; models should remain robust.

In accordance with Article 182(1)(c), IRB-CCF estimates should be quarantined from potential distortions caused by this "**region of instability**". Institutions must ensure their models are robust or adjust estimates adequately to mitigate these effects.

Judgmental IRB-CCFs are allowed only for

immaterial and data-scarce exposures, with conservative MoC and ongoing validation against realised CCFs.

Model-related MoC

Institutions must apply a **margin of conservatism (MoC)** to account for estimation uncertainty in PD, LGD, and IRB-CCF, reflecting statistical errors and data limitations at grade or pool level.
The MoC should consider deficiencies in data, including missing or inaccurate climate-related information, and ensure monotonicity in final estimates. Its size increases with fewer observations, shorter time series, or overlapping default rate dependencies.

Review of Estimates

Institutions must **review their estimates** whenever new information comes to light, but at least on an annual basis. The review should assess whether the estimates remain accurate, stable, and reflective of the institution's actual risk profile and observed default experience. It should cover all model parameters, data inputs, assumptions, and methodological choices, including any expert judgment applied. The scope and frequency of reviews must be commensurate with the materiality and complexity of the models. Institutions are expected to document the outcome of each review, including identified deficiencies, remedial actions, and decisions to recalibrate or redevelop models where appropriate. The review process should be supported by robust governance arrangements and clear allocation of responsibilities between model owners, developers, and the independent validation function.

Calculation of Maturity for Non-retail Exposures

The **maturity parameter** must be the maximum remaining time for the obligor to fully repay all contractual obligations, including principal, interest and fees, based on the facility's expiry date. To comply with Articles 162(1)–(3) CRR [4], institutions must properly justify and document any exemptions from the one-year maturity floor to ensure correct calculation of the maturity parameter.

Conclusions

In light of the updates introduced with the July 2025 edition of the ECB Guide to Internal Models [3], institutions are required to **significantly strengthen** their **internal processes** for the **management** and **validation** of **IRB models**, particularly regarding credit risk parameters (PD, LGD and CCF).
First, banks must ensure that their **calibration processes** fully reflect the new requirements on the **representativeness of historical data, correlation with macroeconomic indicators**, and comparison with **regulatory benchmark references**. Specifically, for PD and LGD, institutions will need to implement structured, well-documented, and replicable analyses capable of demonstrating the soundness of assumptions and their consistency with both market conditions and identified downturn periods.
From a methodological standpoint, institutions should also update their internal frameworks to ensure **full traceability of calibration choices, robust model risk management**, and correct application of the new requirements for **benchmarking** and justification against regulatory reference values (LRA and downturn LGD reference).
Regarding **CCFs**, the introduction of stricter criteria in terms of scope of application, exposure definition, and calculation methodology requires a **comprehensive review of data availability, data extraction processes, and methodological consistency** across operational, risk management, and IT functions.
Finally, the **strengthened alignment with the EBA Supervisory Handbook [1]** calls for a more structured approach to **model**

Topic	New Requirements	Main Activities
PD	Review and update of PD calibration methodology	• Assessment of historical data representativeness (inclusion of at least last 5 years); • Correlation analysis between internal default rates and macroeconomic indicators; • Definition of bad/good years and inclusion of max/min observed DRs; • Justification of deviations from ECB benchmark reference period (2008–2018).
LGD	Review and recalibration of downturn LGD	• Calibration at same level of granularity as LRA LGD; • Identification of downturn years and calculation of benchmark reference value; • Inclusion of both completed and incomplete recoveries; • Comparison between downturn LGD and benchmark value; justification of discrepancies.
CCF	Revision of IRB-CCF framework and recalculation approach	• Application limited to undrawn revolving commitments (excl. 100% SA-CCF); • Introduction of "CCF input floor"; • Alignment with Commitment (CRR Art. 5(10)) and Revolving Commitment (CRR Art. 166(8b)) definitions; • Removal of 0% IRB-CCF option • Specific calculation formula: numerator = drawn amount at default; denominator = committed but undrawn amount; • Fixed reference point 12 months prior to default.
Data & IT Infrastructure	Enhancement of data governance and model input systems	• Verification of data representativeness and quality; • Traceability of data sources used for calibration and validation; • Integration of new macroeconomic correlation analyses.

TABLE 13: Main conclusions.

validation and **audit**, with increased attention to **data quality, methodological documentation**, and the oversight of models based on **advanced techniques**, including **machine learning**.

In summary, the 2025 update of the ECB Guide to Internal Models [3] does not merely introduce technical adjustments but marks a step towards a more coherent, comparable, and transparent supervisory framework. Institutions should therefore plan a structured implementation path that includes:

- **Review and enhancement of credit risk parameter calibration methodologies**;
- **Strengthening of validation and audit functions**;
- **Updating of governance policies and documentation processes**;
- **Verification of model alignment with the new quantitative and qualitative regulatory requirements set by the ECB**.

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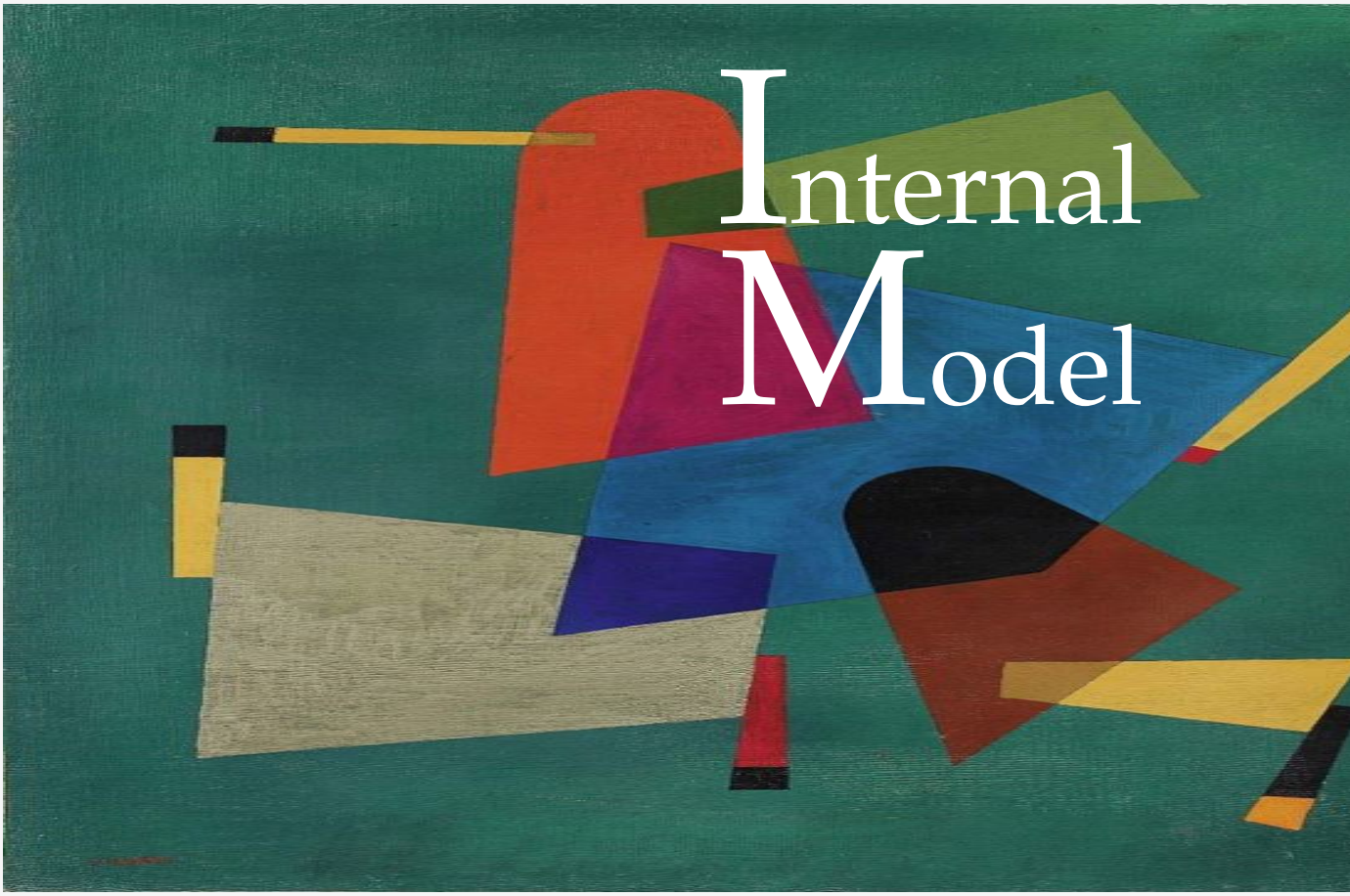

ECB Revised Guide to Internal Models - Market and Counterparty Credit Risk

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This report provides an overview of the main changes introduced by the ECB in its revised Guide to Internal Models ("EGIM") published in July 2025 with respect to the previous version of February 2024, focusing on the Market and Counterparty Credit Risk chapters. Its purpose is to give a general overview of the main topics, shedding light on major innovations and related practical implications for banks in the regulatory and managerial risk frameworks.

Since it was first published in October 2019 [3], the ECB Guide to Internal Models has proven to be a very useful and appreciated tool for financial institutions, as it helps to streamline their model landscapes, allowing them to better choose suitable portfolios for internal models and apply simpler approaches to others; supervisors also heavily rely on its principles when inspecting institutions for initial internal model validation and subsequent model changes. The revised version [5] provides transparency in ECB's understanding of the most significant aspects of the applicable regulatory framework that governs internal models, thus contributing to higher harmonization in supervision. The revision incorporates updates to the regulatory framework and builds on the experience that ECB has gained over the years of supervising internal models.
In general, the revised 2025 Guide maintains, for both market risk and CCR chapters, the same structural and interpretative logic as the 2024 edition [4] but introduces a number of targeted clarifications intended to refine supervisory expectations, improve consistency with the evolving CRR3 framework and strengthen the operational articulation of requirements already established under CRR and CRR2.

Market Risk

The Market Risk topic is now split into two chapters to reflect the coexistence of regulations defined under the CRR2 framework and the regime introduced by CRR3, with its gradual entry into force. Although partially postponed several times, the adoption of CRR3, and especially the Internal Model Approach (IMA) for Market Risk, would mark a substantial regulatory transition. CRR2 had already introduced the Fundamental Review of the Trading Book (FRTB [1]) structure on a reporting basis, including elements such as the Expected Shortfall (ES) metric and the Profit & Loss Attribution Test (PLAT), but without prudential consequences. CRR3 would make this framework binding for Own Funds Requirements determination, establishing PLAT and back-testing results as decisive criteria for the maintenance of IMA permissions at the trading-desk level. The updated Guide therefore consolidates supervisory expectations and reinforces ECB's interpretative role, aligning institutional governance, data quality and model validation with the definitive Basel framework.

CRR2

Scope of the Internal Model Approach

The scope of the IMA continues to be defined in strict accordance with Article 363(1) CRR[1] [6], which allows institutions to calculate their own funds requirements for market risk by using internal models instead of, or in combination with, the Standardised Approach (SA). Both 2024 and 2025 EGIM versions reiterate that institutions may request IMA approval for specific risk categories and trading desks, provided that the internal models are conceptually sound, properly integrated into daily risk management processes and subject to ongoing validation.
The most notable refinement in 2025 concerns the articulation of the "scope consistency" requirement: ECB clarifies that once a trading desk or risk category is included

[1]Notably, CRR2 [7] does not update the articles related to market risk internal models cited in this chapter.

within the perimeter of IMA approval, the institution must ensure that all positions falling within that perimeter are subject to model-based capital treatment unless explicitly excluded in accordance with the procedures established in Section 2.5 of the Guide. This change reinforces the link between Article 363(1) and Article 368(1)(a) CRR, under which the internal model must be closely integrated into daily risk management and reporting processes. ECB's supervisory stance remains unchanged: the IMA must reflect the bank's actual risk management practice, and not merely serve as a regulatory computation tool.

Regulatory Back-Testing

With respect to regulatory back-testing of Value-at-Risk (VaR) models, the 2025 edition largely confirms the methodological expectations set out in the Article 366 CRR, requiring daily comparisons of both actual and hypothetical P&L figures against the corresponding one-day VaR estimates calibrated to a 99% confidence level.

The fundamental supervisory interpretation remains: back-testing is not a purely statistical exercise, but an essential tool for model validation and ongoing performance monitoring. In the 2025 version, however, ECB introduces refinements intended to strengthen data governance and documentation. Institutions are now expected to maintain traceability of all inputs used in the back-testing dataset, including price sources, valuation methods and exceptions handling. ECB further clarifies that institutions must ensure a clear separation between ex-post back-testing and ex-ante calibration adjustments; back-testing outcomes should not be used to fine-tune parameters unless justified within the scope of the model change policy.

The definition of "exceptions" (days when the loss exceeds the predicted VaR) and the treatment of such events remain unchanged. The colour-zone approach (green, yellow, red) continues to be applicable and the link between back-testing performance and the multiplication factor for model-based capital charges remains as previously set. Nevertheless, the 2025 version expands the supervisory expectations regarding the qualitative assessment of exceptions. Institutions are now required to provide a structured root-cause analysis distinguishing between model-related, data-related and idiosyncratic exceptions. ECB explicitly requires that such analyses be included in the internal validation reports submitted to senior management, thereby reinforcing Article 368(1)(e) of the CRR, which mandates established procedures for monitoring compliance with internal policies and controls.

Internal Validation of Market Risk Models

The internal validation framework, one of the central pillars of ECB's supervisory approach, remains conceptually stable. EGIM again emphasise that validation must be performed independently of the model development process, covering conceptual soundness, ongoing monitoring and outcome analysis. The 2025 edition confirms ECB's interpretation of "independence" as organisational separation rather than mere procedural distinction: the validation function must have sufficient authority, access and resources to challenge model assumptions.

The core expectations introduced in 2024 (namely the requirement for independent review of data, parameters, assumptions and the inclusion of both quantitative and qualitative validation techniques) are fully retained. However, the 2025 Guide introduces a reinforced focus on data governance within the validation process. Institutions are expected to maintain a transparent audit trail linking validation samples to the underlying data repositories. ECB clarifies that the validation function should not only test model performance but also assess data lineage and the robustness of data transformations applied prior to model input.

The 2025 edition does not formally introduce a new requirement for continuous validation oversight. However, it reinforces the expectation that institutions should monitor model performance on an ongoing basis through internal back-testing and timely implementation of corrective measures. ECB considers it best practice for internal back-testing to be performed daily, ensuring alignment with the regulatory back-testing program.

Methodology for VaR and sVaR

A strong degree of continuity is highlighted in the methodology for VaR and Stressed VaR (sVaR). More precisely, ECB continues to interpret Articles 365 and 366 CRR as establishing a dual requirement: VaR must capture current market conditions, while sVaR must measure risk under a period of significant financial stress relevant to the institution's portfolio. Both versions confirm the use of a 99% confidence level and a 10-day holding period for both measures, and reiterate the requirement that sVaR be calibrated using historical data from a continuous 12-month period of significant stress. The supervisory expectation that this stress period should be reviewed at least annually is unchanged.

The main difference in the 2025 edition lies in the more explicit articulation of how institutions should demonstrate the representativeness of the stress period. Whereas the previous version limited itself to stating that the chosen stress period should reflect material risks in the institution's current portfolio, the 2025 Guide now requires a documented quantitative justification, including correlation analysis and sensitivity of key risk factors, to prove that the selected period remains relevant. This addition ensures that the model continues to capture "all material price risks" in both normal and stressed conditions.

In relation to VaR and sVaR implementation, it is maintained the requirement that the internal model be based on sound theoretical foundations, free from arbitrary or inconsistent aggregation methodologies. ECB confirms that full revaluation or sensitivity-based approximations remain acceptable as long as they meet the accuracy criteria established by the institution's validation policy. ECB continues to discourage excessive reliance on linear approximations for non-linear instruments unless supported by empirical evidence. Furthermore, the 2025 version clarifies that, under Article 367(3) of the CRR, empirical correlations may be used for aggregating specific and general risk components, provided that the underlying estimation methodology is statistically robust and validated. Where empirical correlations are not applied, a simple-sum aggregation of risk categories remains permissible.

Finally, the 2025 Guide introduces a more precise articulation of data quality and mapping standards within VaR and sVaR engines. Institutions are required to document the process by which risk factors are selected, updated and validated, and to justify the representativeness of proxies where direct data are unavailable. This addition strengthens the supervisory expectation that model inputs be both "objective and up to date" in line with Article 376(2) CRR. ECB explicitly underlines that these data governance principles apply equally to VaR, sVaR and IRC models, creating a consistent supervisory language across the internal model framework.

Methodology for Incremental Risk Charge

The section on the Incremental Risk Charge (IRC) retains in 2025 the same conceptual foundations laid out in the 2024 Guide: ECB continues to define the IRC as a measure intended to capture the incremental default and migration risks associated with credit-sensitive trading book positions that are subject to specific risk capital requirements. The core design features remain fully confirmed and the new version also preserves the emphasis on consistency between the

IRC and the Internal Ratings-Based (IRB) approach for credit risk, stressing that the statistical methodologies used for the estimation of Probability of Default (PD) and Recovery Rate (RR) parameters must be conceptually sound, empirically supported and aligned with the institution's overall credit risk framework.

However, again, the 2025 revision introduces a more granular articulation of supervisory expectations with respect to data governance and model validation. ECB in fact expects institutions to demonstrate explicitly that their PD and RR estimates are based on "objective and up-to-date" data, in accordance with Article 376(2) CRR. Whereas the 2024 Guide expressed this requirement in general terms, the 2025 text demands documentary evidence of data provenance, update frequency and consistency between internal and external data sources. This clarification is accompanied by a strengthened emphasis on cross-framework consistency: where PDs derived under the IRC differ materially from those used under the IRB approach, institutions are now required to analyse and justify the divergence, including the methodological rationale and any compensatory conservatism.

Again, what differentiates the 2025 Guide is the reinforced expectation for model transparency and documentation. ECB now requires that institutions maintain explicit documentation of the statistical estimation process for PDs, including sample selection, calibration technique and treatment of outliers. EGIM stresses that any assumption leading to PDs equal to zero, or implying innatural recovery rates outside the range of 0–100%, must be demonstrably conservative and justified on objective grounds. Moreover, validation teams are expected to quantify estimation error ranges to assess the reliability of parameter estimates, an addition that deepens the supervisory assessment of model uncertainty.

The treatment of fallback PDs also remains consistent with 2024. Institutions may assign conservative fallback PD values only when reliable estimates cannot be derived due to data limitations, in line with Article 376(6) CRR. The 2025 version, however, elaborates further on the periodic reassessment of fallback exposures. It clarifies that where fallback PDs contribute materially to the overall IRC charge, defined as contributing for approximately 10% of total IRC capital, the institution must not only justify this level but also perform additional sensitivity analyses by shifting fallback PDs up and down one rating notch. This requirement, already present in 2024, is now explicitly linked to the independent validation process required under Article 368(1)(b) CRR.

Another important refinement in 2025 concerns the treatment of groups of connected issuers. ECB continues to interpret Article 374(2) CRR as requiring that issuer concentrations and groups of connected clients be modelled as single risks, unless evidence demonstrates otherwise. However, the 2025 Guide enhances the expectation of proportional granularity: while connected issuers within a group should be treated as a single risk, the existence of different rating grades within that group must be reflected through sub-group modelling, allowing for differentiated but correlated migration dynamics.

Risks Not in the Model Engine

ECB continues to read Articles 367(1)(a), 367(1)(b), 368(1)(e) and 369(1) CRR as establishing that all material risks must be captured either within the approved internal models or, where this is not feasible, through the Risks Not In the Model Engine (RNIME) framework. This topic was already one of the most conceptually mature parts of the 2024 Guide so in 2025 it receives a clearer operational articulation rather than a substantive reinterpretation. In fact, the essential structure remains intact: RNIME identification, quantification, management and governance are integral to the institution's overall IMA processes, and RNIME add-ons are to be reported as ad-

ditional risk exposure amounts in COREP (Common Reporting) templates.

What distinguishes the 2025 version is the greater precision in the definition, maintenance and re-assessment of RNIME. The Guide now specifies that each RNIME identified must be recorded in a centralised inventory, accompanied by a description of its scope, quantitative materiality and rationale for exclusion from model engines. Institutions are required to justify any case in which a single RNIME definition is applied across multiple portfolios or product classes. Furthermore, ECB introduces an explicit requirement for periodic reassessment of RNIME classified as immaterial: risks that were previously negligible must be re-evaluated in light of portfolio evolution or market developments. This reflects ECB's intent to ensure that RNIME management remains dynamic rather than static.

The 2025 text also reinforces the governance framework. The risk control unit, already designated under Article 368(1)(b) CRR as responsible for the overall risk management system, is now expressly confirmed as responsible for the RNIME framework as a whole. ECB clarifies that this responsibility extends beyond coordination to active oversight of RNIME identification, quantification and remediation processes. Internal validation must verify not only the quantitative adequacy of RNIME add-ons but also the soundness of the identification process itself. Additionally, EGIM formalises the requirement for institutions to implement documented escalation procedures in cases where RNIME exposures become material and persist without timely remediation.

CRR3

One major novelty in the 2025 version of EGIM is found in the inclusion of a section related to CRR3. The guide clarifies that, under CRR3[8], market-risk capital requirements must be determined through a framework that is both risk-sensitive and operationally integrated into institutions' governance structures. Internal models are now considered not only analytical instruments but key components of the prudential decision-making process. ECB expects model outputs to inform pricing, valuation, limit-setting and capital allocation on a continuous basis.

The interpretative stance confirms that the IMA remains the central mechanism through which institutions can align regulatory capital with internal risk measurement.Models are expected to reflect the true risk profile of portfolios rather than relying on simplifications that underestimate potential losses.

EGIM specifies that IMA approval is granted at the trading-desk level, reinforcing accountability at the point where risk is generated. Each desk must operate under a defined mandate and risk limits consistent with the institution's broader framework. Approval is conditional: it can be restricted or withdrawn when deficiencies are identified in validation, data quality, or governance. ECB expects trading-desk heads and control functions to demonstrate how the model is embedded in business operations and how its outputs influence decisions on risk appetite and hedging.

The prudential philosophy consolidated through CRR3 places emphasis on model governance and the interaction between quantitative results and qualitative oversight. Institutions must maintain comprehensive documentation of:

- Assumptions;
- Data sources;
- Model design;
- Parameter updates.

EGIM stresses that documentation should support traceability and facilitate supervisory review by the Joint Supervisory Teams (JSTs).

Scope of the Internal Model Approach

The 2025 EGIM builds on the CRR3 legal framework for internal models under Article 325az(2), clarifying the supervisory process for granting, maintaining, restricting and withdrawing IMA permissions at the trading-desk level. The Guide considers desk-level permission as an expression of supervisory accountability: responsibility for model performance, data quality, and risk-factor representation must reside as close as possible to the point where risk is generated.

Under Article 4(1)(86) CRR3, trading-book positions comprise instruments held for trading intent or to hedge other trading-book exposures. ECB demands institutions to maintain a clear and consistently applied perimeter that captures positions subject to active risk management and fair-value measurement. Perimeter governance must ensure traceability from business intent to booking, valuation, and risk aggregation, with effective controls preventing opportunistic perimeter shifts.

Within this perimeter, the Guide establishes that institutions must clearly define which positions are covered by the IMA and which remain under the SA. Eligibility should reflect:

- The model's effective coverage of material risk factors;
- The availability and quality of data;
- The results from Profit and Loss Attribution Test (PLAT) and back-testing.

EGIM differentiates between general market-risk components and specific risk positions, such as issuer-specific spread and default risk. Institutions are expected to model specific components explicitly, with validation evidence showing that idiosyncratic drivers are accurately captured and not systematically understated. Where specific risk is insufficiently represented due to modellability constraints, data gaps, or structural approximations, ECB expects recourse to the SA for the affected instruments.

Transfers between trading and banking books must remain exceptional and reflect a genuine change in business intent. The Guide requires prior approval by senior management and supervisory notification pursuant to Article 104(3) CRR, supported by documentation outlining rationale, timing and the effect on capital and risk. Internal hedges are acceptable only when they represent an actual transfer of economic risk and must not be used to artificially reduce capital. Institutions should ensure consistent recognition of internal hedges across pricing, valuation adjustments, risk measurement and P&L processes, supported by clear audit trails. Each trading desk is treated as a self-contained unit of measurement and control, with a defined mandate, documented limits, product scope, valuation framework and monitoring arrangements. Desk-level accountability enables targeted supervisory measures: permission may be limited, suspended, or withdrawn for a specific desk if deficiencies are identified, without affecting other desks. ECB expects institutions to demonstrate that desk-level risk figures inform pricing, valuation adjustments, limit setting, stress testing and capital planning.

Where IMA approval is sought on a consolidated or sub-consolidated basis, EGIM expects consistency in methodologies, risk-factor mapping and data lineage across entities. Institutions must ensure coherent governance, model documentation and uniform control standards, including common data dictionaries, transformation rules and exception-handling procedures. Group-level applications should avoid reliance on local idiosyncrasies that undermine comparability. When justified differences exist, institutions must show that outcomes remain commensurate and traceable at both group and entity levels.

IMA applications must provide a complete, reproducible dossier covering:

- Model design and scope;

- Risk-factor taxonomy and modellability evidence;
- Data sources and quality controls;
- Implementation architecture, PLAT and back-testing frameworks;
- Results, stress testing, governance and roles;
- Internal audit coverage;
- Change-management procedures.

ECB expects end-to-end traceability from transaction booking to capital figures, including versioning, parameter provenance and reconciliation logs between pricing and risk engines.
Permission is not static: maintenance requires ongoing monitoring, timely remediation of deficiencies and transparent escalation. Repeated or unresolved findings in PLAT, back-testing, or validation may lead to conditional permissions, restrictions in model scope, or reversion to the SA. Perimeter decisions should be reassessed periodically in light of business evolution, risk profile and supervisory feedback, ensuring that capital outcomes remain credible and comparable.
ECB places particular emphasis on data integrity and the alignment between front-office pricing engines and risk engines. Institutions must maintain coherent market-data hierarchies, mapping rules and transformation controls, supported by reconciliation procedures that identify and explain divergences. Where risk engines apply approximations, institutions must evidence that these do not compromise the faithful representation of pricing drivers used in front-office systems. Persistent misalignments identified through PLAT must trigger corrective actions and, where necessary, scope adjustments.
EGIM recognises proportionality in IMA adoption. Institutions may retain the SA for desks or products where internal modelling is not justified by materiality, complexity, or data availability. However, once included in the IMA perimeter, desks must meet the full set of supervisory expectations for governance, validation, data quality, PLAT and back-testing, and continuous monitoring.

Regulatory Back-Testing and Profit & Loss Attribution

Within the CRR3 market-risk framework, back-testing and PLAT represent the core supervisory instruments through which ECB assesses the reliability of internal models at trading-desk level. ECB interprets these tests not as isolated statistical validations, but as mechanisms of continuous supervisory engagement designed to verify that internal models reproduce the economic reality captured by front-office systems.
The PLAT is central to ECB's interpretative framework because it explicitly connects risk engines and pricing engines. Although interdependent, these two environments fulfil distinct purposes: pricing engines, typically operated by the front office, are designed for accuracy and responsiveness, performing full revaluations based on granular market data and conventions; risk engines, by contrast, apply simplifications and mappings to produce consistent capital metrics. ECB interprets the PLAT as the supervisory bridge between these two systems, ensuring that the simplifications introduced for capital purposes do not undermine the faithful representation of market risk.
The test compares the hypothetical P&L generated by front-office pricing systems with the hypothetical P&L produced by risk engines used for capital calculations. Its purpose is to determine whether the risk factors, sensitivities and valuation methodologies embedded in the internal model capture the same economic drivers that explain daily trading results. When discrepancies arise, ECB expects institutions to conduct a structured root-cause analysis distinguishing between representation gaps, data inconsistencies, mapping errors and valua-

tion differences. Persistent or unexplained divergences indicate inadequate model integration, which ECB considers a material supervisory deficiency.

ECB clarifies that the PLAT is not a binary pass–fail exercise. Although CRR3 defines quantitative thresholds — grouped into three zones (green, amber, and red) based on correlation and unexplained P&L ratios — ECB focuses primarily on the quality of analysis and governance surrounding the results. Trading desks that persistently fall within the amber or red zones must present credible remediation plans addressing the underlying causes, such as data misalignment, risk-factor underrepresentation, or inappropriate sensitivities. Insufficient remediation may lead ECB to restrict or withdraw the desk's IMA permission.

The back-testing framework, established under Article 325bf CRR3, serves as the quantitative complement to the PLAT. ECB expects institutions to compare their daily model-based risk measures — historically VaR and now ES, with both hypothetical and actual P&L observations over the most recent 250 business days. Two separate back-tests are required:

- The hypothetical P&L back-test, which isolates changes due solely to market-risk factors under a static portfolio assumption;
- The actual P&L back-test, which incorporates realised trading activity, including intraday adjustments and new positions.

ECB interprets back-testing as an ex-post validation of model accuracy, while the PLAT functions as a real-time diagnostic of model integration. Together, they enable supervisors to identify weaknesses in either model calibration or system linkage. Institutions must investigate each overshooting individually, documenting whether it results from data errors, temporary market events, or structural model deficiencies. Frequent or unexplained overshootings trigger intensified supervisory scrutiny and may result in the migration of the affected desk to the standardised approach.

ECB's interpretative stance treats the PLAT and back-testing as complementary pillars of supervisory assessment. The PLAT verifies internal consistency — the degree of alignment between pricing and risk engines — whereas back-testing evaluates external accuracy, measuring predictive reliability. Jointly, they provide a comprehensive view of model performance, integration and governance quality.

Institutions are expected to embed both tests into their broader risk-management framework, using their outcomes to refine valuation models, recalibrate sensitivities and adjust stress scenarios. ECB places particular emphasis on governance: results of both PLAT and back-testing must be escalated to senior management, validation and internal audit, ensuring that deficiencies are identified, documented and remediated in a transparent and timely manner.

Internal Validation of Market Risk Models

Under CRR3, the supervisory interpretation of internal validation of Market Risk remains consistent with that outlined in the corresponding section of the CRR2 chapter. ECB considers the principles, governance arrangements and methodological expectations previously defined to remain fully applicable, with no additional specificities introduced under the revised framework.

Methodology for Expected Shortfall and Stressed Scenario Risk Measure

CRR3 replaces the VaR measure previously used under CRR2 with the ES as the primary risk metric within the IMA. ECB interprets this reform as a structural enhancement to the prudential framework, improving risk sensitivity and ensuring a more accurate reflection of losses under severe but plausible market conditions. The transition from a quantile-based VaR to a tail-average ES marks a conceptual shift in prudential

philosophy: ES captures the mean of losses beyond the 97.5^{th} percentile, ensuring that extreme events previously underestimated under the VaR framework are incorporated into capital requirements.

ECB interprets the ES framework as enhancing coherence between model-based capital requirements and institutions' actual risk exposures. It reflects the non-linear behaviour of trading portfolios characterised by optionality, basis risk and volatility sensitivity. ES must capture both general and specific market-risk components, ensuring that issuer-specific, curve-specific and cross-currency effects are appropriately represented. Risk measures derived from ES should be stable across market cycles, responsive to changes in risk factors and empirically validated against historical performance. Institutions must demonstrate that their ES estimation methodologies remain conservative, unbiased and supported by robust data governance.

ECB requires ES to be computed separately for each regulatory risk class — interest rate, credit spread, equity, foreign exchange, and commodity — before aggregating across classes using the correlation framework prescribed in CRR3. EGIM clarifies that regulatory correlations act as prudential floors, not as targets. Empirical correlations may be used, provided they are demonstrably conservative or statistically justified. Within each risk class, institutions must ensure sufficient granularity to capture all material sources of variation. Correlation structures must remain robust under stress, accounting for the potential breakdown of diversification in crisis conditions. ECB expects systematic correlation stress testing and quantitative assessments of how adverse co-movements affect capital outcomes, ensuring that diversification assumptions do not artificially reduce own-funds requirements.

Central to the ES framework is the treatment of risk factors within the model. ECB expects institutions to maintain an exhaustive inventory of risk factors driving valuation changes across trading desks. Each factor must be classified as modellable or non-modellable in accordance with Article 325be CRR3. A factor is modellable if reliable real-price observations exist — at least twenty-four over the previous twelve months — allowing statistically sound calibration. Where data are insufficient, discontinuous, or unrepresentative, the factor must be treated under the Non-Modellable Risk Factor (NMRF) framework.

ECB views the NMRF regime as a prudential safeguard that prevents reliance on subjective or synthetic estimates for poorly observable risks. The classification between modellable and non-modellable factors must be data-driven, transparent and consistently applied. Institutions are required to document data sources, observation frequency and modellability methodologies, maintaining a clear audit trail and governance oversight. The NMRF charge must be computed using conservative stress scenarios consistent with portfolio liquidity characteristics. ECB expects appropriate liquidity horizons, market depth assumptions and holding periods aligned with realistic exit conditions. The resulting NMRF capital add-on supplements ES to capture the full spectrum of market risk, including tail risks not observable through historical calibration.

For modellable factors, calibration must rely on objective, verifiable data that reflect prevailing market conditions. ECB expects the use of sound statistical methodologies — historical simulation, filtered historical simulation, or Monte Carlo approaches — ensuring accurate tail estimation and avoiding volatility smoothing that could understate risk. Calibration choices and data-cleaning procedures must be documented and validated. Where multiple data sources are employed, reconciliation should preserve the economic meaning of risk factors across systems and ensure data lineage consistency.

ECB clarifies that the use of proxies for risk factors is acceptable only where direct market data are unavailable or insufficient and

where the proxy demonstrates a stable and economically justified relationship with the underlying factor. Institutions must document the rationale, construction method and statistical validation of each proxy, including evidence of correlation stability and representativeness over time. ECB expects periodic back-testing of proxy performance and independent validation of the mapping between the proxy and the original risk factor. Proxies used for valuation or risk measurement must:

- Preserve the economic meaning of exposures;
- Not introduce artificial smoothing or bias in ES estimation.

Persistent reliance on unvalidated or poorly performing proxies is considered inconsistent with prudent model governance and may trigger supervisory restrictions or add-ons under the NMRF framework.

ECB places particular emphasis on the alignment between ES calculation and front-office pricing. Pricing engines and risk engines must be reconciled so that identical risk factors, conventions and valuation methodologies are applied, or deviations are explicitly justified. Simplifications used in risk engines are acceptable only when they do not compromise the faithful representation of sensitivities captured by pricing systems. Persistent mismatches identified through the PLAT must trigger prompt corrective action and, where needed, scope or calibration adjustments.

Under Article 325bc CRR3, institutions are also required to compute the Stressed Scenario Risk Measure (SSRM), ensuring that model outcomes remain conservative under historically adverse conditions. ECB interprets the SSRM as embedding "stress memory" into the model — linking current exposures to past periods of extreme volatility. The SSRM must be calibrated over a continuous twelve-month stress window relevant to the institution's portfolio, maximising the ratio between stressed and current ES. This ensures that capital requirements reflect the most adverse configuration of risk factors historically observed. ECB expects institutions to review the stress period at least annually and to ensure consistency between volatilities, correlations and risk factors derived from that period. Selective or fragmented use of extreme events across different time intervals is considered non-compliant.

Calibration stability and conservatism are key supervisory expectations. ES and SSRM estimates must remain responsive to portfolio evolution but should not produce excessive volatility in capital figures. ECB expects institutions to benchmark results against alternative specifications, conduct sensitivity and reverse stress analyses, and justify any recalibration that materially affects capital outcomes. Unexplained decreases in ES or SSRM may be interpreted as indicators of model deterioration or underestimation of tail risk and trigger supervisory follow-up.

ECB's interpretation of the ES framework extends beyond methodological soundness to the "use test", which requires that ES and SSRM results are integrated into the institution's risk management and governance processes. Internal limits, trading mandates, valuation adjustments and stress testing must consistently reflect ES-based metrics. Results should be embedded in management dashboards and trigger escalation when internal thresholds are breached. ECB links the credibility of internal models to their demonstrated influence on decision-making and capital planning. A model that is statistically sophisticated but operationally isolated does not meet supervisory expectations.

Methodology for Default Risk Charge

The Default Risk Charge (DRC) complements the ES by capturing potential losses from issuer default and credit migration within the trading book. ECB interprets the DRC as a structural enhancement that

integrates credit-related tail risk into the market-risk capital framework, ensuring that credit-sensitive instruments are treated consistently with their risk profile. The DRC replaces the Incremental Risk Charge (IRC) of CRR2, extending its coverage and methodological discipline under the Basel FRTB framework. While the IRC quantified incremental default and migration risk for selected credit portfolios, the DRC considers defaults only and applies this logic to all trading-book positions exposed to credit-spread and default risk (e.g., incl. equity derivatives), thereby eliminating the fragmentation that previously existed between market and credit risk modelling.

ECB views this transition as a fundamental improvement in scope, calibration and prudential consistency. The DRC applies a one-year horizon and a 99.9% confidence level, requiring explicit modelling of both defaults and systemic correlations. Institutions must map instruments into issuer buckets by rating, seniority and sector, capturing both long and short exposures. Particular attention is expected for index and tranche positions: ECB requires full decomposition into underlying constituents to ensure risk sensitivity. Securitisation exposures remain excluded, as they fall under dedicated frameworks.

Calibration must rely on through-the-cycle data, adjusted for downturn effects, and based on migration matrices consistent with internal or external ratings. Recovery-rate assumptions must remain conservative and empirically justified. Correlation structures must differentiate between systemic and idiosyncratic risk components, capturing sectoral and regional dependencies. Again, ECB expects institutions to demonstrate the statistical robustness of correlation parameters and to conduct stress tests on potential correlation breakdowns. Diversification effects must be empirically demonstrated; unsupported correlation reductions may be disregarded or subject to supervisory add-ons.

ECB expects consistency between DRC parameters and those applied in IRB frameworks, while acknowledging methodological differences in horizon, granularity and scope. Calibration must use long historical series and external benchmarks to ensure representativeness. The validation process must assess conceptual soundness, empirical accuracy under historical default or spread-widening episodes, and implementation integrity. Weaknesses must be documented, escalated and tracked through formal remediation. Institutions must ensure that DRC models follow the same governance, validation and monitoring standards applicable to ES models, with periodic updates of default and migration data, justified recalibrations and transparent reporting.

Risks Not in the Model Engine

Under CRR3, the supervisory interpretation of RNIME remains aligned with the framework set out in the corresponding section of the CRR2 chapter. ECB considers the principles governing identification, quantification and governance of unmodelled risks to remain fully applicable, without introducing additional methodological or procedural specificities.

Risk Management, Governance and Audit

ECB interprets governance as the structural foundation of the IMA under CRR3. The prudential reliability of market-risk models depends not only on statistical accuracy but on how models are embedded within the institution's governance, control and decision-making framework. Governance must ensure clear accountability, transparent ownership and effective oversight of all activities related to model design, validation, use and change management.

ECB expects institutions to establish a comprehensive governance structure integrating model ownership, independent validation, model-risk management and senior management oversight. Responsibilities

for model development, validation and approval must be functionally segregated to prevent conflicts of interest. The model-risk management function should possess sufficient authority, technical expertise and organisational independence to challenge assumptions, identify weaknesses and escalate issues to the board-level risk committee. ECB views this structural separation as a safeguard ensuring prudential integrity and sustained objectivity throughout the model lifecycle.

Documentation is a central pillar of supervisory assessment. Institutions must maintain complete, current and internally consistent documentation covering model design, data lineage, calibration methodology, validation outcomes and governance processes. Documentation must enable reproducibility of model outputs and demonstrate compliance with the approved IMA perimeter. ECB expects institutions to maintain a detailed audit trail of model changes, including the rationale, methodological adjustments, implementation details and impact on capital requirements. Incomplete or inconsistent documentation is regarded as a material weakness that undermines the credibility and transparency of internal models.

Ongoing monitoring extends governance into continuous practice. Institutions must monitor model performance, parameter stability and data quality through quantitative indicators and qualitative reviews. ECB expects regular reports summarising:

- Back-testing and PLAT outcomes;
- Validation findings;
- RNIME and NMRF updates;
- Remediation status.

These reports must be integrated into internal management information systems and reviewed by senior management and the risk committee with sufficient frequency to enable timely corrective action.

ECB interprets the use test as a cornerstone of prudential governance. Risk measures derived from ES, SSRM, DRC and RNIME must actively inform the daily management of trading-book exposures, including limit setting, pricing verification, stress testing and capital allocation. Models that operate in isolation from business processes do not satisfy supervisory expectations. Institutions must demonstrate that quantitative outputs influence strategic decisions and that management actions are traceable to those model results.

Ongoing supervisory assessment under the Single Supervisory Mechanism (SSM) builds upon these expectations. JSTs review documentation, validation reports and monitoring evidence to evaluate the coherence and credibility of model use. ECB places emphasis on the quality and clarity of governance evidence rather than the volume of documentation. Timeliness of escalation, clarity of responsibilities and robustness of decision-making are key indicators in determining whether internal models remain eligible for continued approval.

In conclusion, ECB interprets governance within the CRR3 market-risk framework as the operational discipline linking methodology, validation, data integrity and accountability. Through rigorous documentation, clear responsibilities and continuous supervisory dialogue, institutions must demonstrate that their internal models remain technically sound and prudentially credible. This approach encapsulates ECB's supervisory philosophy: robust internal models derive reliability not solely from mathematical precision but from the governance structures ensuring their consistent, transparent and responsible application across all stages of the risk-management process.

Counterparty Credit Risk

In the chapter devoted to Counterparty Credit Risk (CCR), EGIM clarifies the scope and objectives of the Internal Model Method (IMM), which is used to calculate capital requirements for exposures to counterparties. ECB reiterates that the Guide

does not introduce new rules but rather explains how the provisions of CRR, as updated by CRR3, are to be interpreted and applied. The structure of the chapter remains aligned with the Targeted Review of Internal Models (TRIM) framework, ensuring consistency and comparability across institutions. The chapter applies both at the individual and consolidated levels, requiring consistency between the two.
In summary, the 2025 update enhances the clarity of the regulatory framework and aligns the Guide with the revised CRR structure, particularly regarding maturity computation. Although the substantive content and supervisory expectations remain unchanged, the update provides additional clarification on how to model risks arising from transactions with counterparties.

Trade Coverage

An important concept for CCR under the IMM is the scope of transactions, that govern the calculation by netting set, the authorisation and sequential use of the IMM and the related validation and control requirements. ECB addresses carve-out situations, in which certain transactions belonging to a recognised netting agreement are treated under a non-IMM method, and explains how such cases should be managed through the creation of synthetic netting sets within the same contractual netting agreement.
In line with Article 294(1)(l) CRR, ECB confirms that institutions must have a framework capable of identifying material pricing-model deficiencies at the transaction level. When pricing deficiencies are identified, ECB considers the preferred corrective measure to be the carve-out of the affected transactions to a non-IMM method. Institutions should also create synthetic netting sets if price differences persist beyond a predefined threshold, ten business days per quarter is considered good practice. Alternatively, ECB underlines other corrective actions may be taken, provided they:

- Are well-justified;
- Are regularly validated;
- Ensure that the model does not systematically underestimate exposure.

In all cases, institutions are expected to address promptly the root causes of pricing differences between the IMM and the benchmarking system. For transactions that remain within the IMM despite identified pricing differences, ECB confirms these discrepancies must be reflected in the exposure calculation: best practice is to adjust the initial transaction value to match the benchmark value and to apply further adjustments over future time points so that the Effective Expected Exposure Profile (EEPE) after correction is not lower than that obtained without correction. Persistent pricing differences that are not remediated and lead to a systematic underestimation of exposure may be considered by ECB as a violation of Article 292(1) CRR, potentially triggering supervisory measures for the affected transaction types. Transactions that have been carved out, for instance due to pricing differences with the benchmarking system, do not count towards the required IMM coverage.

Margin Period of Risk

ECB clarifies that the "most recent exchange of collateral" under Article 272(9) CRR also covers situations where a margin call has been issued and is due to settle shortly thereafter. Accordingly, the default time is not necessarily immediately at the start of the Margin Period Of Risk (MPOR) but could occur at a later point in time and this reflects the operational lag inherent in collateral processes without compromising model conservatism. Because illiquidity determines the appropriate MPOR length, ECB requires institutions to define both quantitative and qualitative criteria to identify it. Portfolios should be monitored not only in terms of Fair Value Hierarchy Level assignment, but also using indicators such as:

- Product type;
- Market depth;
- Price observation frequency;
- Maturity;
- Currency;
- Issuer concentration.

As in the previous version of EGIM, ECB permits multiple methodological approaches to MPOR simulation, including forward and backward modelling, provided they produce consistent and conservative exposure estimates. Moreover, ECB requires institutions to validate any interpolation or extrapolation techniques, such as Brownian Bridge interpolation, used to estimate exposure at additional grid points within the MPOR. These validation requirements extend to ensuring that the interpolation error remains immaterial relative to full revaluation outcomes which is an essential part of the back-testing obligations.
Institutions should assume that no further margin calls are received after the MPOR starts. ECB confirms that trade-related cash flows may be recognised only if they are consistent with the Default Management Process (DMP) and the timing of the counterparty default. Instead, when no DMP exists, ECB requires a conservative assumption that all trade-related cash flows from the institution should be paid to the counterparty during the whole MPOR.
In this version, ECB introduces further specifications concerning the possible payments by any party which are due during the MPOR:

- Any trade-related cash flows should be netted using the contract's close-out rules, while margin calls may be treated as paid or not depending on default timing, communication processes and contractual terms;
- If the margin agreement allows margin and trade-related cash flows to be offset within a defined time window, the resulting net cash flow should replace the separate value changes mentioned above.

Furthermore, ECB reiterates that, if an institution obtains a material deviation in the EEPE from the results expected under the DMP, ECB may exercise its power to increase the alpha multiplier used in EAD calculation: this adjustment effectively acts as a capital add-on and serves as a prudential safeguard against the underestimation of counterparty exposure.
Finally, EBC recommends institutions to regularly review their portfolios for concentrations, illiquid collateral positions and hard-to-replace derivatives, supported through regular validation of methodologies, filters and stress scenarios.

Collateral and Initial Margin Modelling

As in the previous version, ECB provides detailed supervisory guidance on how institutions should model both cash and non-cash margin collateral. This includes capturing potential value changes between the last margin call at the start of the MPOR and its end.
ECB recalls that, when collateral is non-cash or denominated in a different currency from the exposure, institutions must treat it in one of two ways: it can be jointly modelled with the exposure or subject to volatility adjustments, with any residual FX risk captured at the end of the MPOR.
When a contractual margin agreement contains both IMM and non-IMM trades under a single netting agreement, ECB confirms the creation of synthetic netting sets to allocate the collateral proportionally between IMM and non-IMM trades to avoid double counting, in line with Article 272(17) CRR.
Regarding Initial Margin (IM), which is the collateral required to absorb potential losses arising between the last margin exchange and the liquidation or hedging of positions, ECB emphasises its dynamic nature under

the IMM. In fact, IM is driven by the simulated risk factors and by the volatility of the remaining transactions within the netting set, and the model must reproduce this behaviour to prevent systematic underestimation of the exposures.
Moreover, ECB stresses again the importance of regularly benchmarking the collateral and initial margin values modelled at time t_0 against the respective actual ones to be able to correct any significant differences to prevent underestimation of exposure.

Maturity, Time Steps and EEPE Computation

For the purpose of calculating the EEPE, an important role is played by the maturity which affects the shape of the Expected Exposure time profile. Furthermore, this parameter is also involved in the estimation of the parameter M used in the calculation of the Risk Weighted Assets (RWAs) for institutions using the IRB approach.
The most significant change introduced in the 2025 edition by ECB concerns the updates to maturity computation, which have been aligned to CRR3. ECB expects institutions to establish a structured hierarchy for calculating the parameter M using distinct formulas depending on the type of transaction. For example:

- Unmargined derivatives subject to a master netting agreement;
- Fully collateralised margin lending transactions with notional weighting across transaction;
- SFTs under netting agreements depending on margining frequency and portfolio composition.

Moreover, ECB further distinguishes between transactions with maturities shorter or longer than one year. If the longest-dated contract in a netting set matures within a year, the effective maturity is determined using the weighted average of transaction maturities; if instead it exceeds one year, different expressions are used, subject to a five-year cap, unless the one-year limit is met.

Calibration, Use Test and Validation

The calibration frequency has both regulatory and risk-management dimensions. For Pillar 1 purposes, ECB recalls that calibration to current market data should be performed at least quarterly, but increased in frequency whenever there are material changes in market conditions that could affect exposure profiles. For internal risk management instead, ECB regards as best practice to recalibrate the parameters of the underlying stochastic models (such as drift, volatility and correlation) at least monthly, since outdated calibrations may no longer reflect current market conditions or accurately represent the exposure profile.
In addition to regular calibration, ECB requires the institutions to maintain a stress calibration, as stipulated in Article 284(3)(b) CRR, to ensure resilience against systemic shocks. ECB confirms the importance to calibrate EPE model parameters using data from the identified stress period (i.e., three-year in the case of historical data) representing adverse credit and market conditions, applying the same estimation method as for current calibration. This includes parameters for market risk simulation, pricing and collateral valuation, which should be reviewed and adjusted if needed. Upfront implementation before approval for all model extensions is promoted by ECB, as well as for model changes that affect:

- Exposure levels (e.g. due to changes in risk factor forecasting);
- Data management/supply (e.g. due to changes of input data);
- Significant IT systems (including software changes);
- Regular quantitative validation.

Back-testing remains the core validation tool and, for this reason, ECB expects it

to be performed and reported at least once a year. At a minimum, testing at risk-factor level is mandatory and additionally ECB requires to complement it with runs on both actual and hypothetical portfolios, and useful ensuring samples are representative and capable of detecting weak performance. Moreover, ECB underlines that institutions should:

- Quantify and explain coverage;
- Adapt statistical tests where forecasts overlap in time;
- Give particular attention to pricing-function validation if both predictions and realisations are produced by IMM rather than an external benchmark.

Where direct exposure back-testing of margined sets is impracticable, in the view of ECB, separate validation of the margining process, collateral value changes and netting-set market-value changes over relevant horizons are expected. Furthermore, ECB confirms that a routine benchmarking of IMM revaluation prices against an independent system should be in place, together with a validated process for identifying significant price differences and for testing the corrective actions taken, including adjustments to future grid points.

Risks Not in Effective Expected Positive Exposure

Depending on the IMM set-up and the nature of the transactions, certain quantificable risks may be uncaptured or only partially captured by the EEPE and therefore are not included in the exposure value under Article 284(4) CRR: they are denominated as Risk Not In Effective Expected Positive Exposure (RNIEPE). Actually, this is a fairly recent concept as it was introduced only in the previous 2024 EGIM version since it was completely absent in the initial one. To tackle such risks, ECB sets out two treatments:

- Apply a RNIEPE framework (which may include voluntary RNIEPE add-ons for substantial RNIEPE);
- Include such risks directly in the exposure value, immediately or after a short deferral.

EBC reminds that the RNIEPE processes, methods and governance must be an integral part of the IMM's overall processes and governance, consistently with the corresponding RNIME from Market Risk, and, accordingly, the framework should contain guidance for identification and quantification, monitoring, management, reporting and all related governance arrangements. ECB recalls that a "single identified RNIEPE" is a distinct risk not accurately captured in, or fully omitted from, EEPE; this can be a single factor, a set of factors or an element missing from margining or other assumptions. According to ECB, RNIEPE can arise where:

- A single factor, a set of risk factors or the dependency structure (correlations) of a subset of risk factors cannot be modelled precisely enough for the joint distribution;
- Processes do not allow margin arrangements to reflect all terms and specifications required;
- Cash flows paid to a defaulting counterparty in margined trading are not, or not fully, reflected in EEPE owing to DMP or legal terms.

Institutions should document how each RNIEPE is identified and ECB confirms that if a RNIEPE is substantial in the current portfolio, it should be a best practice to apply an add-on even if it may cease to be substantial later. ECB confirms that a "RNIEPE add-on" is a temporary risk analogue to an exposure amount until the corresponding RNIEPE is incorporated into EEPE in a manner compliant with the regulatory requirements of the IMM. As such, ECB considers that RNIEPE add-ons are not part of the

Topic	New Requirements	Main Activities
Data Quality & Infrastructure	• End-to-end lineage from FO pricing systems to risk-engine outputs; • Transparent data ownership, reconciliation, and quality controls.	• Map data lineage linking FO pricing inputs to risk-engine risk factors; • Implement automated reconciliation routines and data-quality KPIs; • Ensure consistency across trade capture, pricing data, and regulatory reporting.
Use Test & Business Integration	• Active internal models managerial use across FO and risk functions; • Outputs from both engines to management, hedging and capital decisions.	• Integrate ES and PLAT metrics from FO and risk engines into limit-setting and hedging processes; • Evidence the use of risk measures in trading and management decisions; • Report model-use evidence to senior risk committees.

TABLE 14: General updates related to EGIM.

Topic	New Requirements	Main Activities
Margin Period Of Risk (MPOR)	• Cash flows not covered by margin calls or generated in default management must be included during the MPOR.	• Re-calibrate IMM models to reflect new exposure profiles; • Monitor potential increases in EAD and RWA.
Maturity	• New definitions of maturity following Article 162 CRR.	• Update M formulas within IMM framework; • Manage longer computation times and infrastructure costs.
Risks Not In Effective Expected Positive Exposure (RNIEPE)	• New compensation measure introduced in EGIM 2024.	• Create dedicated inventory and governance framework; • Develop new tools for challenging quantification.

TABLE 15: Main updates related to EGIM with focus on Counterparty Credit Risk.

EEPE itself and are therefore not included in the exposure value calculated.

Since identified RNIEPE are part of the IMM, according to ECB each RNIEPE should be quantified fairly similarly to IMM exposure: when possible, either as an expected exposure averaged over one year or as an increment to EEPE, taking into account relevant stress calibrations. For each RNIEPE add-on, the risk exposure amount is:

$$RWA_{RNIEPE} = RW \cdot \alpha \cdot ERE,$$

where RW is the SA/IRB risk weight per the CRR (dependent on the number of affected counterparties) and α is the parameter included in Article 284(4) CRR (including potential increases).

Moreover, ECB confirms that institutions are expected to establish their own thresholds, based on the ratio of the ERE over the EEPE in which regard no RNIEPE are to be included in the denominator, for determining when an individual RNIEPE becomes substantial; nevertheless, a suggestion is made to consider the same thresholds exposed in the Market Risk section. As for all IMM processes, ECB also requires efficient monitoring for RNIEPE, at least quarterly[2], as well as an exaustive documentation, in an appropriate and standardised format, of the framework's policies which should include the descriptions of each RNIEPE with justification for non-inclusion in EEPE, tasks, responsibilities and frequencies. As the RNIEPE framework forms part of the broader IMM processes, any changes to RNIEPE identification, impact quantification or add-on methodology con-

[2]In line with Article 10 of the SSM Regulation [9].

stitute IMM model changes which should generally be notified to supervisors. Discontinuing RNIEPE capitalization strictly in accordance with the approved RNIEPE framework thresholds does not constitute a model change and therefore does not require separate notification, provided that it is consistent with the approved methodology. Incorporating an individual RNIEPE into the EEPE always constitutes an IMM model change and must be assessed under ECB Guide on Model Approval (EGMA) [2].

Conclusions

The transition from CRR2 to CRR3 within the ECB Guide to Internal Models (EGIM 2025) represents a clear evolution from interpretative guidance to operational enforcement. Under CRR2, comparing to 2024, ECB refines supervisory expectations for credit-risk parameters under the IRC, introducing stricter documentation of data sources and validation evidence, and reinforcing the need for consistency between IRC and IRB frameworks. With the introcution of CRR3, the Guide operationalises these principles: supervisory expectations are now translated into traceable processes, measurable criteria and evidence-based governance.

ES replaces VaR as the central risk metric, accompanied by the SSRM, while NMRFs and RNIME are explicitly codified as prudential components of model completeness. Similarly, the DRC, conceptually continuous with the IRC under CRR2, consolidates credit-risk capital requirements within the trading book through a fully standardised treatment.

For banks, regulatory evolutions — and especially the PLAT for IMA approval — imply a set of demanding activities. Institutions must reinforce data lineage and reconciliation between FO and risk engines, extend validation to system and infrastructure coherence, and ensure that internal models are demonstrably used in daily management. The EGIM 2025 framework thus converts internal modelling into a continuous assurance mechanism, requiring evidence of integration, transparency and prudential reliability across all model components.

Overall, the 2025 update introduces no major methodological changes to the CCR framework compared with 2024. ECB's focus remains on consolidating implementation quality, data consistency and model governance across institutions. The implementation of the RNIEPE framework, first introduced in 2024, is still progressing across institutions, as banks continue to integrate RNIEPE quantification, governance and reporting into their internal models.

CRR3 introduces only limited adjustments to the treatment of maturity within EEPE and RWA computations but expands the range of cases considered, particularly regarding margining and collateralisation structures. These refinements, together with more detailed modelling of cash flows and margining dynamics during the MPOR, increase computational complexity and infrastructure demands.

The supervisory direction remains clear: ECB is transitioning from assessing conceptual compliance to evaluating operational robustness. In the CCR domain, this means verifying the stability and traceability of exposure modelling, the adequacy of stress calibration and the effectiveness of validation in capturing data, system and governance risks. The 2025 EGIM thus consolidates the CCR framework as an area of supervisory continuity — focused less on new requirements and more on ensuring that existing standards are fully implemented, documented and verifiable.

A recap of key implications related to updates in EGIM is summarized in the tables: Table 14 refers to generic topics, while Table 16 and Table 15 are focused, respectively, on Counterparty Credit Risk and Market Risk.

Topic	New Requirements	Main Activities
Expected Shortfall (ES) & Aggregation	• ES (97.5%); • Full alignment between FO pricing and risk.	• Reconcile ES methodologies and factor coverage between FO and risk engines; • Ensure liquidity horizons and aggregation logic are consistently implemented; • Integrate ES outputs into P&L attribution, capital computation and limit monitoring.
Stressed Scenario Risk Measure (SSRM)	• Consistent stress period in ES, DRC, and NMRF across FO and risk engines; • Justified, documented and periodically reviewed systemic stress scenario.	• Define and justify the stress period with input from FO and risk teams; • Align stressed calibration and scenario application across both engines; • Automate recalculation and integrate it into model-governance cycles.
Profit & Loss Attribution Test (PLAT)	• Tight consistency between FO pricing and risk engines.	• Automate daily PLAT comparison between FO and risk engines; • Analyse and document any persistent deviations or breaches; • Escalate findings and implement remediation through model-risk governance.
Back-Testing (ES/VaR Legacy)	• Regular reconciliation and validation of FO–risk outputs.	• Align FO and risk market data and valuation sources; • Investigate and document exceptions and remediation actions; • Feed outcomes into validation and performance monitoring; • Transitional coexistence of VaR and ES for back-testing.
Non-Modellable Risk Factors (NMRF)	• FO – risk engine reconciliation of not sufficiently represented risk factors; • Transparent and conservative quantification methods.	• Maintain a NMRF inventory mapping FO pricing factors to those in risk engines; • Quantify unmodellable factors using justified approximations; • Reassess modellability periodically and report through governance.
Risks Not in Model Engine (RNIME)	• FO pricing engines and risk engines reconciliation to identify risk drivers not captured within the model perimeter.	• Maintain a detailed RNIME register linking FO and risk-engine components; • Quantify prudential add-ons transparently and reproducibly; • Escalate unresolved RNIME through model-risk oversight.
Default Risk Charge (DRC) / Incremental Risk Charge (IRC)	• Aligned parameters with IRB data.	• Align PD/LGD parameters and issuer mappings between FO and risk systems; • Ensure DRC methodologies remain conceptually consistent with IRC logic and supervisory expectations.

TABLE 16: *Main updates related to EGIM with focus on Market Risk.*

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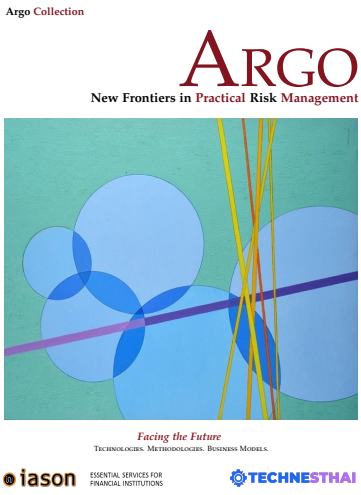

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