

# Chartis

## RiskTech Quadrant

### Category Leader

### Model Validation Solutions, 2019



Thank you for joining us. The Changing Landscape of Model Risk Management webinar will begin at 10:00am PT | 1:00pm ET.



# Webinar: The Changing Landscape of Model Risk Management

March 2019





## Mark Feeley

Research Director, Chartis

Mark has over 30 years' experience in global capital markets, consulting and associated technologies, focusing on risk management, front- and middle-office platforms and data management. He brings to Chartis a holistic view of business, technology and regulatory issues across the enterprise, and how these issues can be addressed by leveraging appropriate technology solutions. His primary focus has been risk technology.



## Anamaria Pieschacon, PhD

Senior Economist, Moody's Analytics

Anamaria is the Global Head of Model Validation for Consumer Credit Risk at Moody's Analytics. She is responsible for leading validation projects and has specialized expertise in credit risk model development, energy economics, and macroeconomic forecasting. The Moody's Analytics team was recognized by Chartis Research as a Category Leader in the Model Validation Solutions 2019 report.



## Michael J. Denton, PhD

Director, Risk and Finance Advisory, Moody's Analytics

Michael helps firms improve decision-making and enhance compliance capabilities. He offers deep experience in the energy, agriculture and commodities markets, with strong functional capabilities in strategic decision support and in building and aligning risk comprehension within the senior management team. His technical background includes market econometrics, asset valuation, risk quantification, and forecasting.

# Agenda

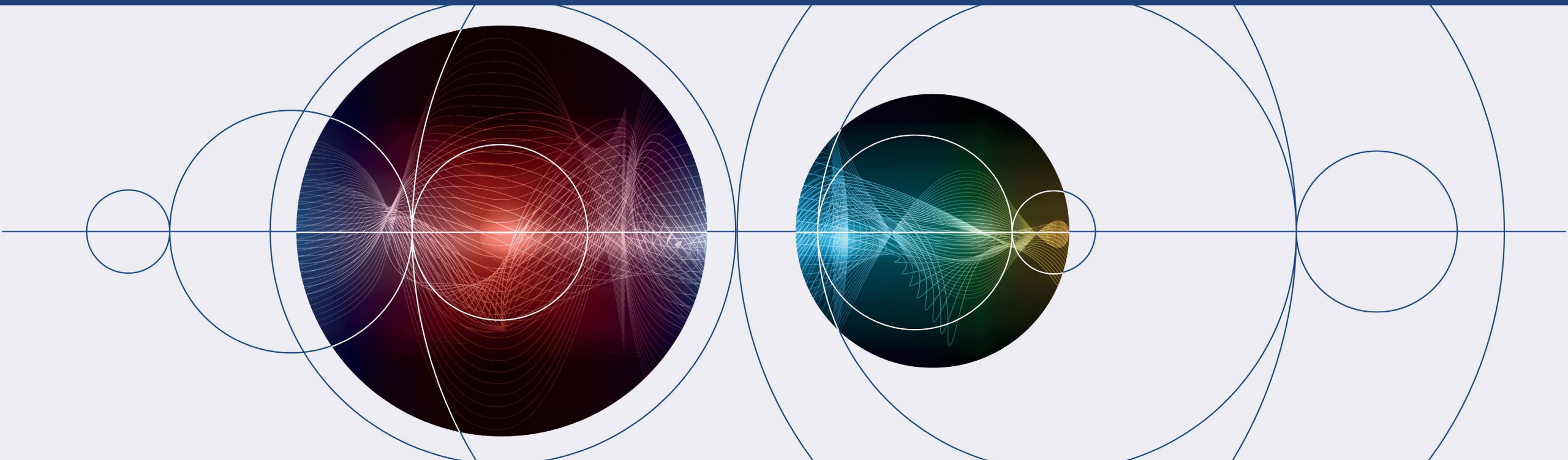
1. Model validation primer and outlook
2. Changing landscape of validation
3. Key challenges - Retail
4. Key challenges - Commercial
5. Q&A

1

Model Validation: Output,  
AI, Problems. Oh my!

# Model Validation Trends and Issues

March 26<sup>th</sup> 2019



# What is Model Validation

The historical view of model validation has been focused largely on the calculation or pricing part of model usage

Model validation is broader than this and must encompass the whole process of model governance, management, usage and environment

This view means that not just the model itself needs to be validate but how it is used, the applicability in the current market environment, the data used by the model and how the results are used

This view becomes even more critical when the models in question are broader than just a pricing or core analytic but may be work flow, AI or behavioral in nature

This view is in line with the increasing need to not just confirm the model is operating as designed but the results and decisions made in getting to them can be explained and defended

## 2. Transparency and Reporting

The validation of models needs to be in line with a current regulation and FIs' internal model risk governance requirements. Therefore models need to be validated over the necessary timescales. The process needs to be transparent and reports appropriate for regulatory approval.

## 1. Input Data Validation

Data validation is a key stage of model validation. Vendors should ensure that data they provide is validated and suitable for the model. Alternative data from the original input can also be used to check the validity of the model.

## 3. Model Suitability/Limitations and Assumptions

The appropriateness of the model for its use case should be evaluated, and its limitations and assumptions documented.

## 4. Remediation

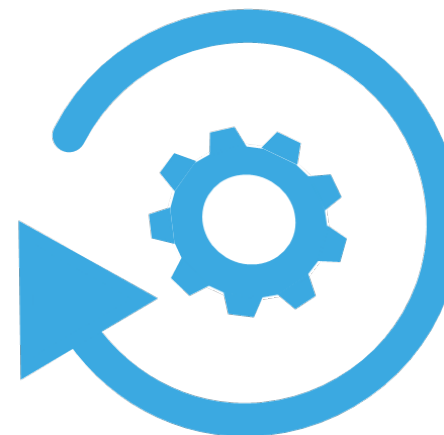
The remediation process is part of a cyclical model validation. Amendments as a result of validation results should be conducted transparently, recorded and revalidated.

## 5. Output Validation

Output validation is the assessment that output calculations are accurate and fall within risk thresholds. This can be tested using techniques such as performance tracking or regression tests.

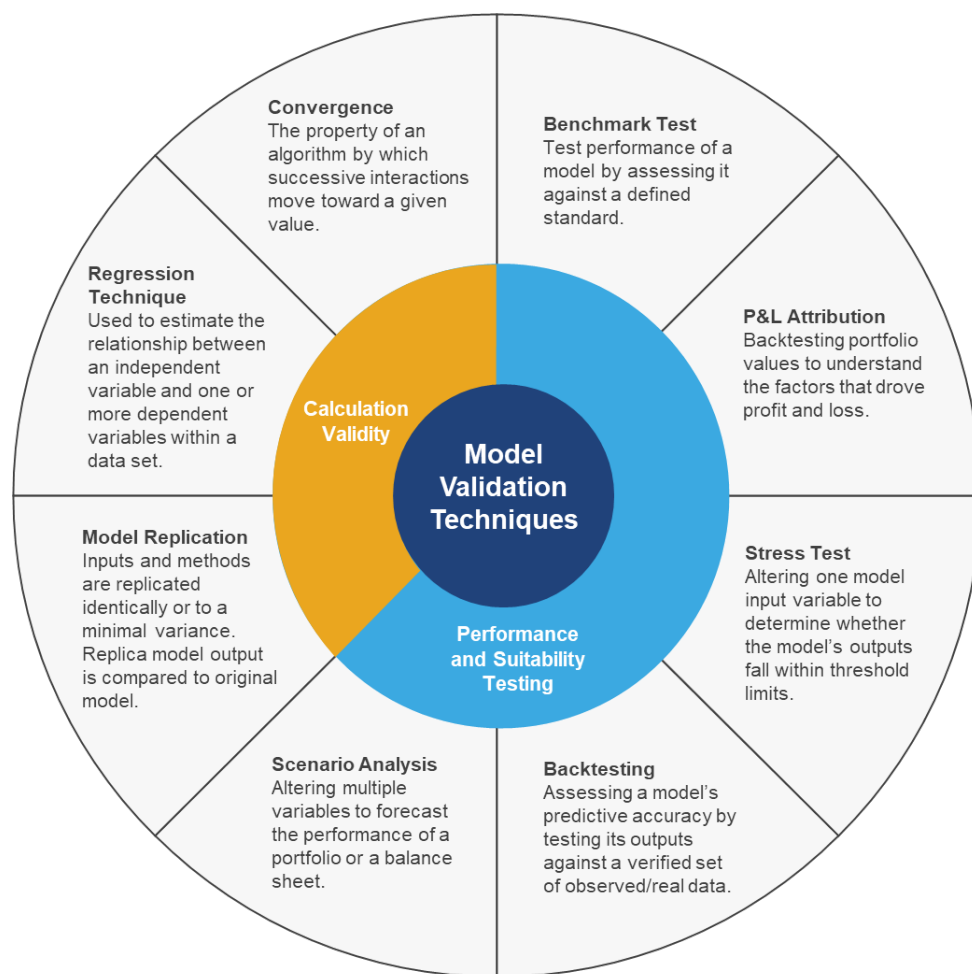
## 6. Output Data Validation

Checking the accuracy and validity of data.



# Types of Output Validation

## Two Core Areas



### Calculation Validity

- » Can we confirm the value
- » Are results consistent across versions or differences as expected
- » Does the model converge on the right value if applicable

### Performance and Suitability

- » Does the model align to benchmark or market observations
- » Does it model changes in variables or market/environment conditions
- » Does it perform overtime and follow the observed trends
- » If it is a pricing model does it drive an accurate P&L view
- » What are the boundaries of applicability



# What about AI

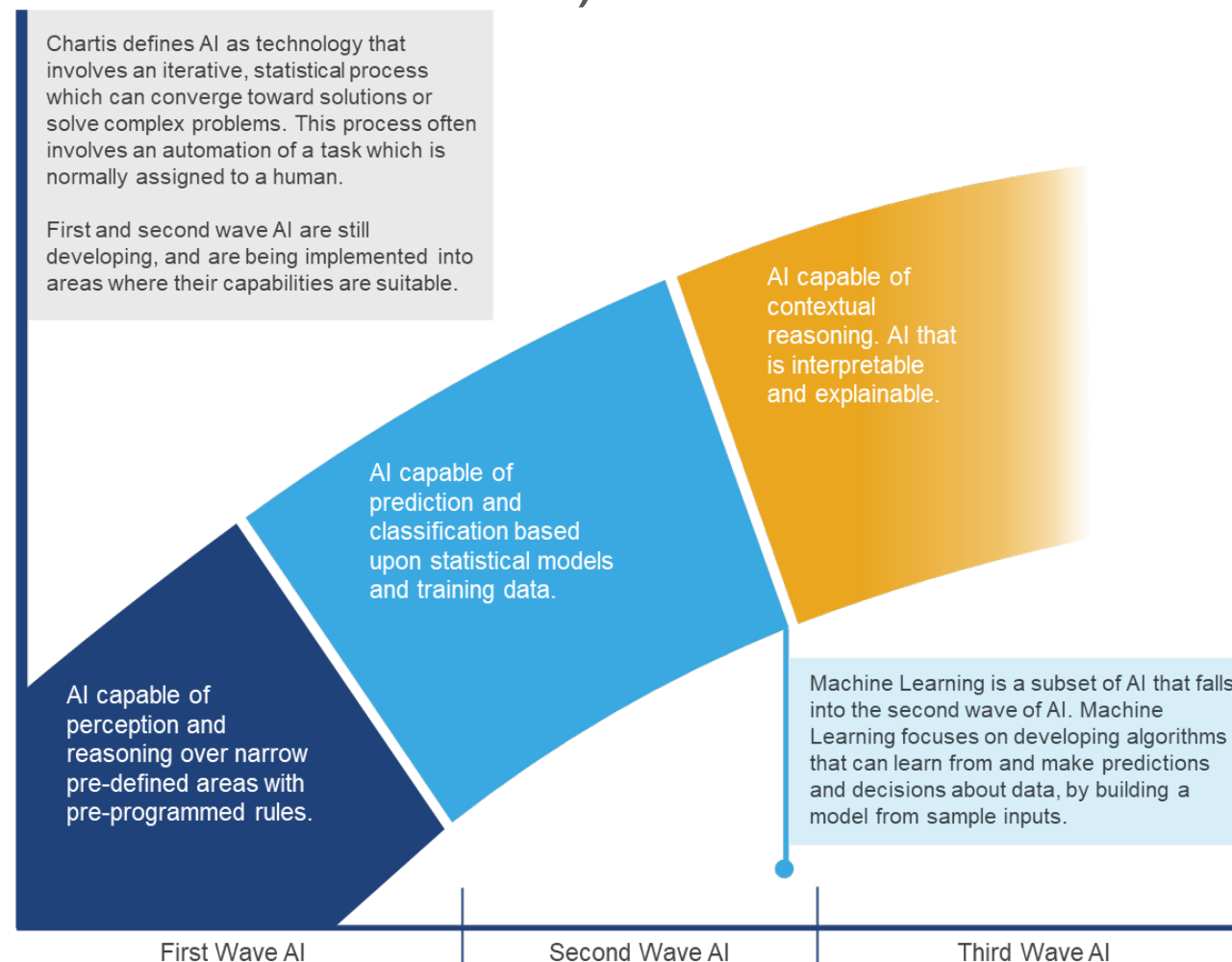
## AI brings two core challenges (be it ML or “true AI”)

### Explainability

- » Current levels of AI (level 1 or 2) frequently suffer from “black box” concerns
- » Both management and regulators/supervisors need to be able to interpret and explain the results from an AI model or process which is driving the need for XAI and level 3
- » AI is often part of a chain or work flow and is making decisions on the path or approach for further downstream processes. This needs to be transparent and reviewable, we are seeing NLG dawning here

### Bias

- » The model depends on the data and there is a risk of training incorrect behavior through data selection bias or quality issues
- » Knowing which data points were observed and why



# Bear in Mind....

## Market Events

### LIBOR replacement

- Lack of historical data
- Unknown behavior

### FRTB and other regulation

- Huge amount of validation to be done
- The regulations will keep coming

## Data Bias

- **Data selection bias** can occur when the source data is not properly randomized; it might reflect historical bias, or be unrepresentative because bits are missing.
- **'Survivorship' bias** concludes that data that has 'survived' represents all data
- **Programming bias.** The unconscious or conscious bias that may be programmed into code by its writer.
- **Data mining bias.** Correlations are assumed between events when in fact the relationships are the result of chance or other causes (one example might be over-estimating the efficacy of a trading strategy).

## Characteristics of Success

- Comprehensive Approach
- Transparency and Explainability
- AI will apply not just to the model itself but how it interacts with users through tools like NLP and NLG



2

Changing Landscape

# Changing Landscape of Validation

We provide validation and advisory services for all aspects of model risk management



## Loan Lifecycle Management Models

Application, Pricing, Origination, Monitoring, Loss Mitigation, Disposition



## Credit Portfolio Management Models

Risk Appetite, Concentration Risk, Counterparty, Operational, etc.



## Regulatory Capital & Stress Testing Models

Basel, CCAR, PRA, EBA etc.



## Business & Strategic Planning Models

Credit Policy, Marketing, etc.



## Financial Reporting

IFRS 9 and CECL



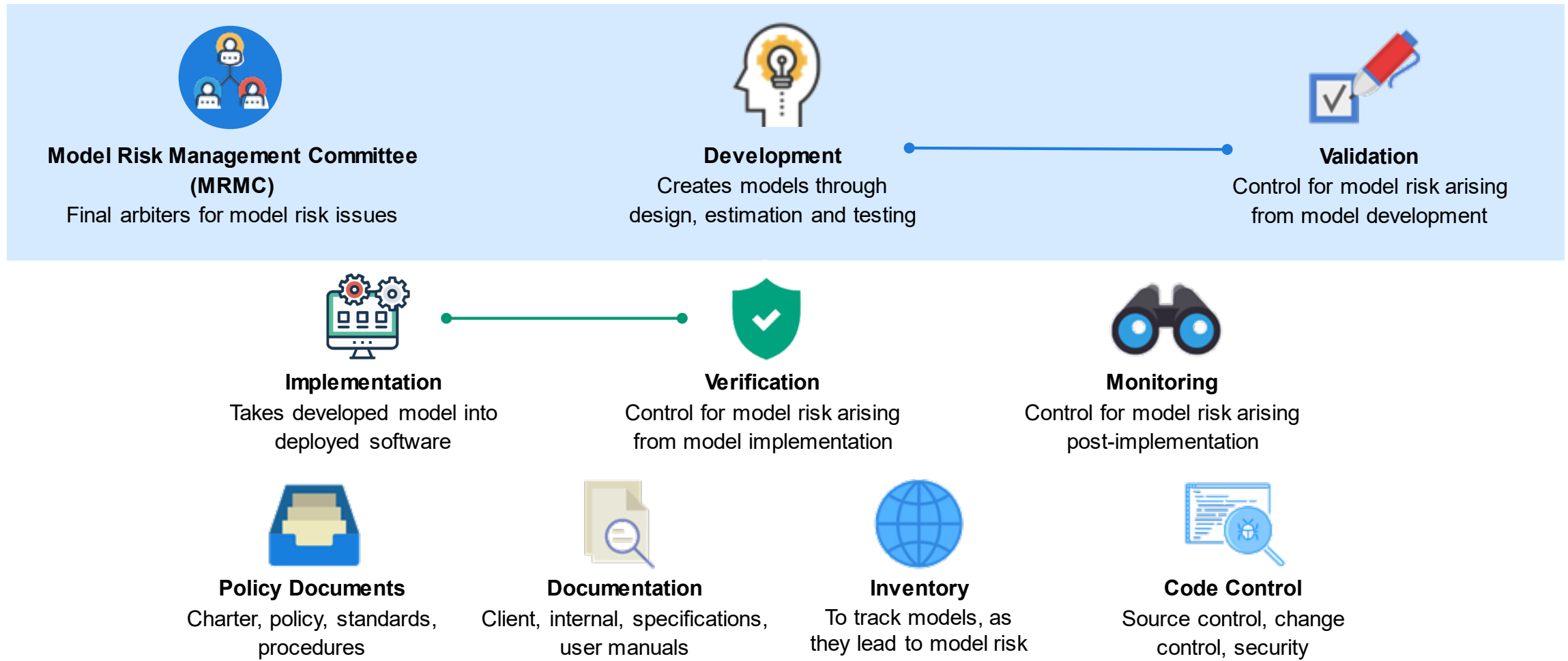
## Other Advisory Services

Gap Analysis, Best Practices and Model Governance



# Changing Landscape of Validation

Our take on validation: why it is important



# Moody's Flexible Approach

We accommodate to a wide range of client needs and portfolio sizes

Validation service offering is designed to match the model complexity and state of model risk management program

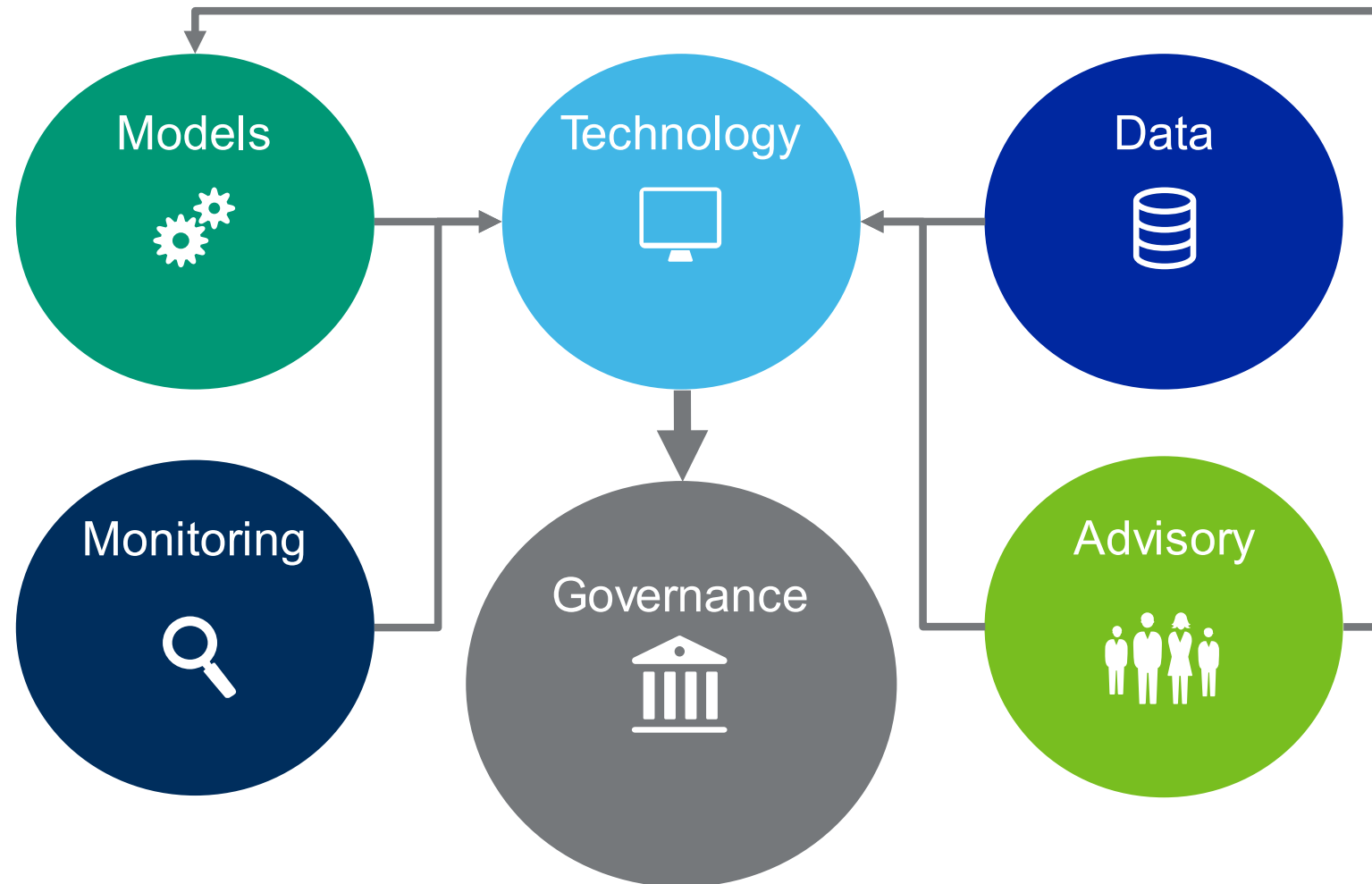


- » Rudimentary model risk management program that often lack sufficiently detailed expectations on model inventory, model development, review, implementation, and control process
- » Simple models based on accumulated experience and consensus that provide repeatable framework for decision making
- » Models as well as the implementation of the model risk management program is often siloed

- » Advanced model risk management program with detailed policy documents, standardized procedures, and robust governance framework
- » Complex models developed using large amounts of data using advanced statistical techniques
- » Models are interconnected and changes to models have upstream and downstream impacts. Change control is importance for successful implementation

# Our Vision for Model Risk Management

Combine Technology with Expertise to Provide the Best Solutions for our Clients



3

Key Challenges - Retail



# Key Challenges



## Scorecard Models

Target Variable Definition & Classification

Variable / Feature Selection

External Validity



## Machine Learning

Interpretability

Non-linearities

Data Demands



## Stress Testing

Data Availability

Peer Comparisons

Nature of Next Severe Shock

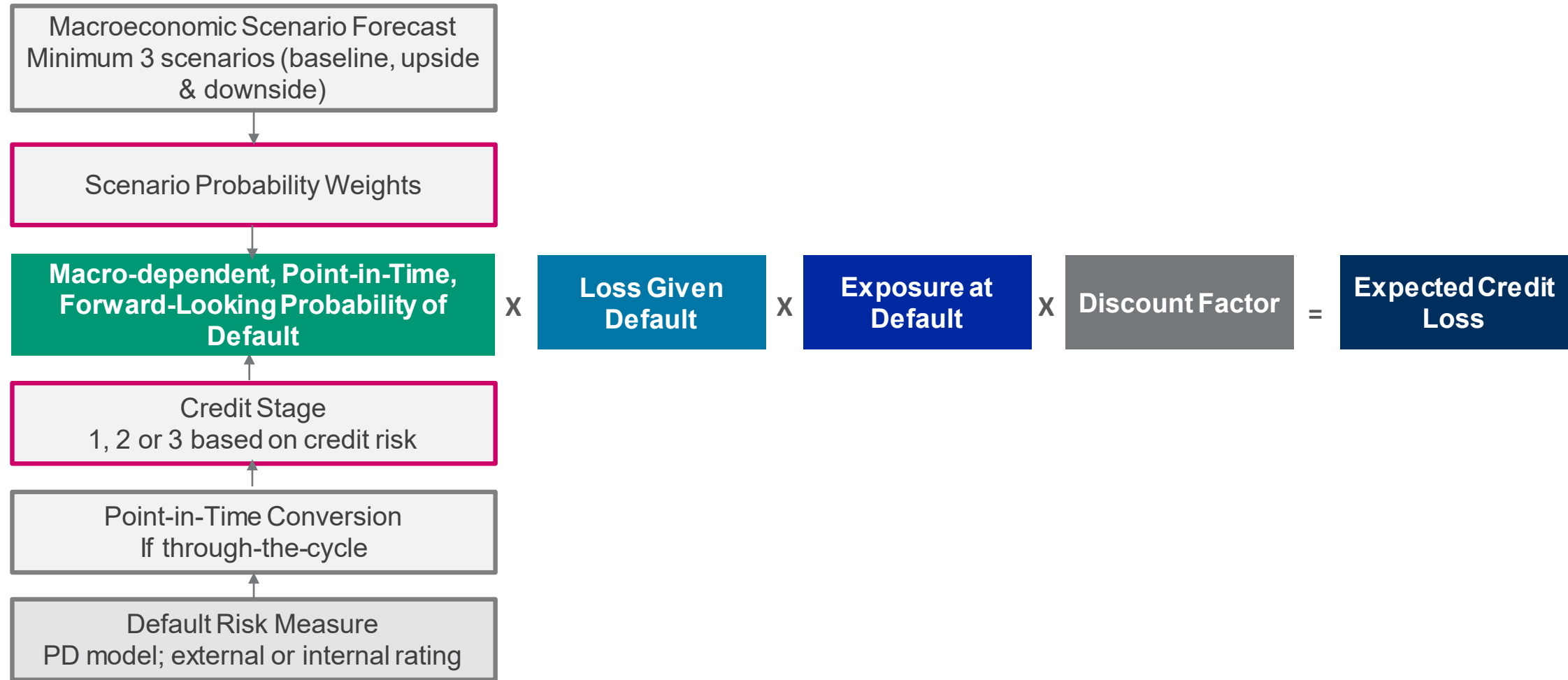
# CECL Model Validation

## Frequent questions

- » How am I incorporating forward-looking information?
- » How do I determine and defend reasonable and supportable horizon?
- » How do I determine the lifetime of the loan?



# Key Challenges: IFRS 9



4

Key Challenges -  
Commercial



# Commercial Banks Risk Modeling has Matured



**Model Risk  
Management**



**Vendor Models**



**Bespoke Models**

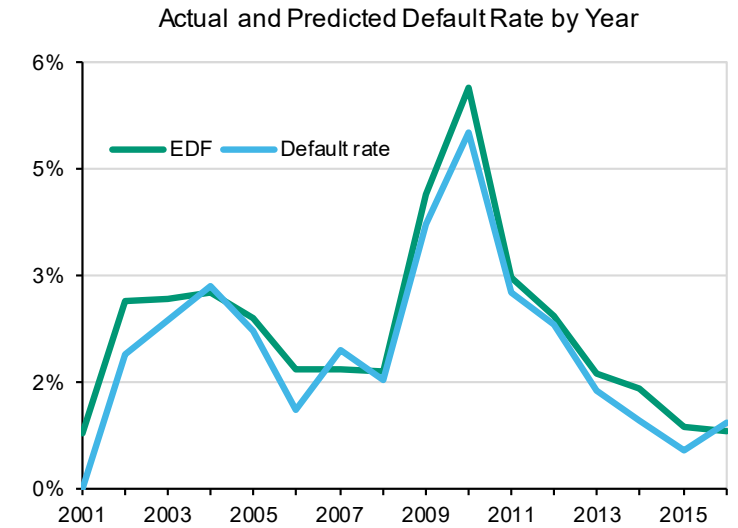
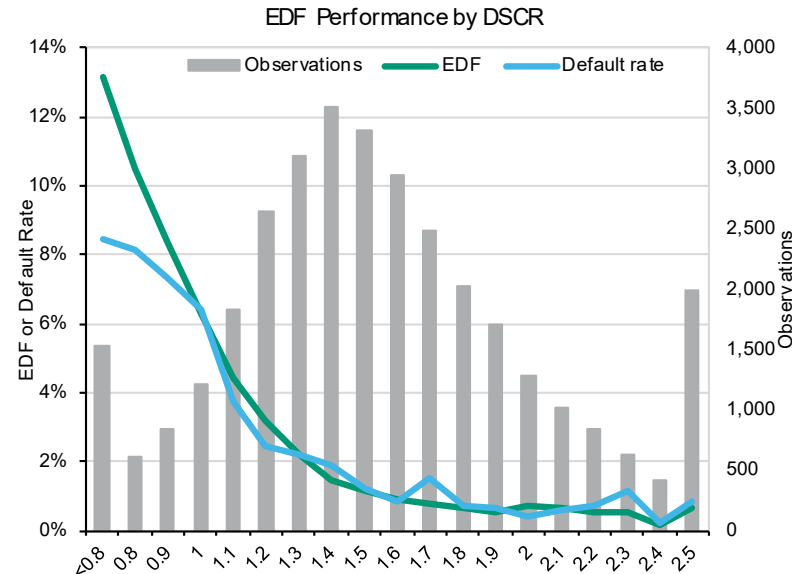
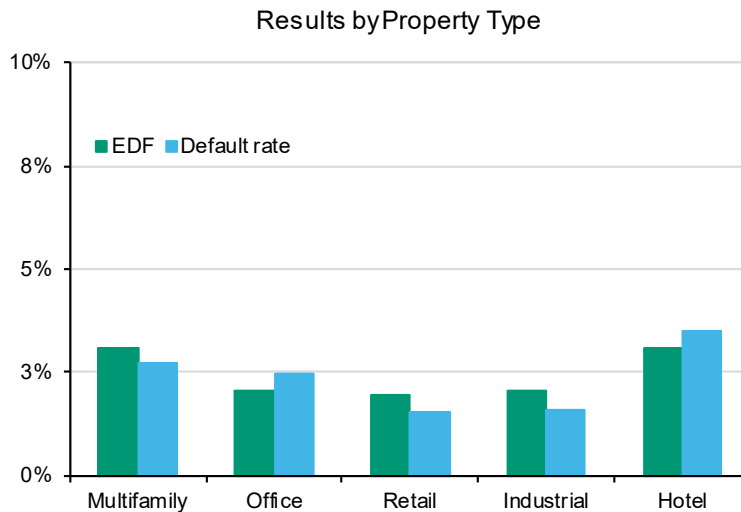


**Specialty  
Portfolios**

- » Critical validation needs now reflect a more mature commercial banking sector, focused on efficiency and leveraging results
- » Requirements have become more complex with CECL, Basil III, FRTB; which have expanded the scope (market risk) and the evaluation tenor
- » Some elements of the validation process have become standardized and/or automated

# Credit Risk Model Validation and Testing

EDF Back-testing results (Commercial Real Estate example)



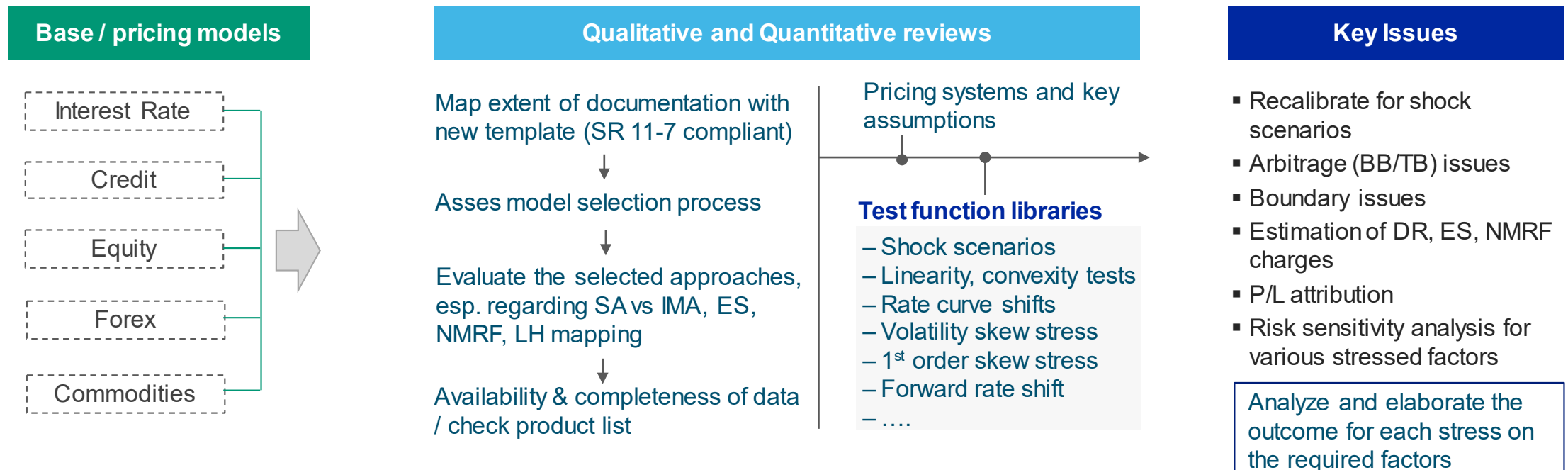
## Automation is making some activities more efficient

- » Comparing the characteristics of the model development sample with the client portfolio
- » Collecting and grooming client data, building proxy portfolios (where necessary),
- » Performing back-tests and numerical analyses to evaluate discriminatory power and level accuracy

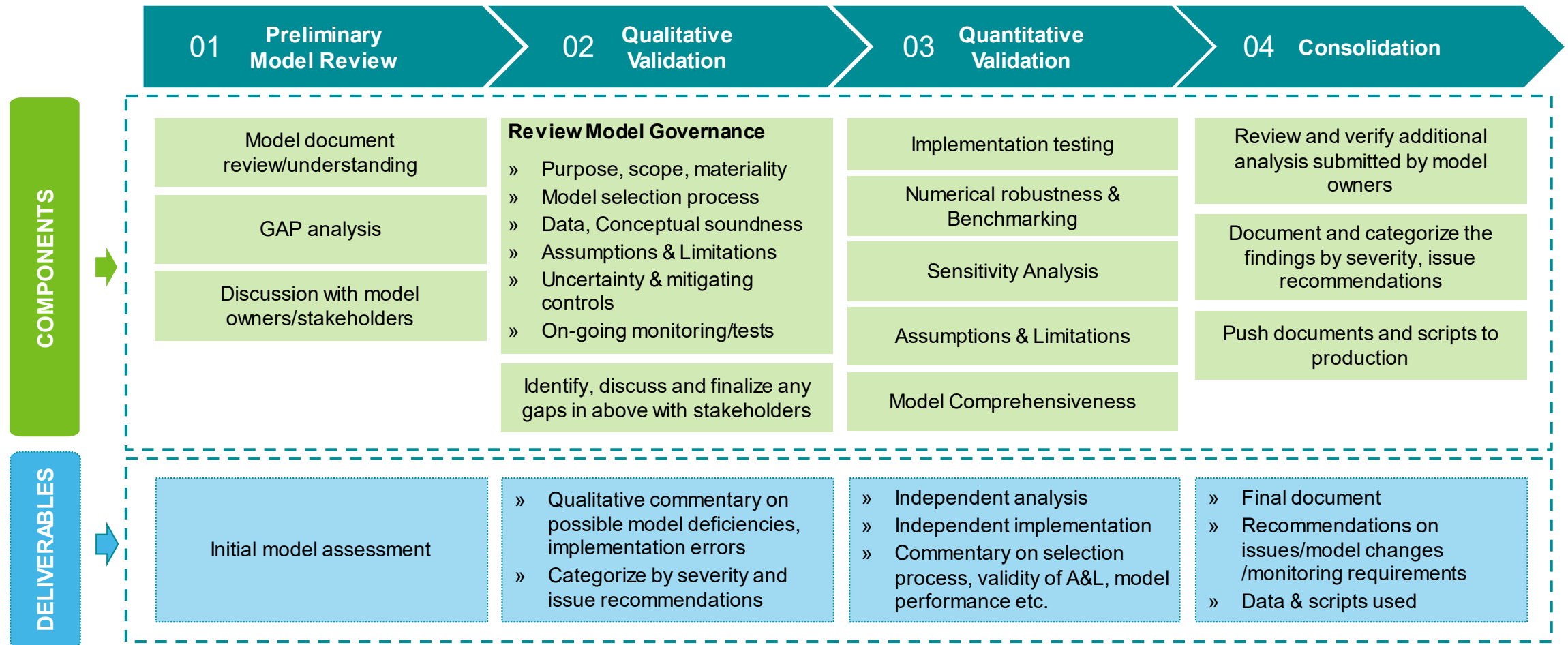
# Market Risk Model Validation and Testing

Impact of market movements and credit degradation on asset values

- » Trading Book is in-scope, in addition to the Banking Book, under FRTB guidance
- » Revised Standardized Approach (SA) is conservative, but less complex than the Internal Model Approach (IMA)
- » Validation requires a blend of SME and automated tools/processes to efficiently validate and test



# Model Validation: Engagement Process





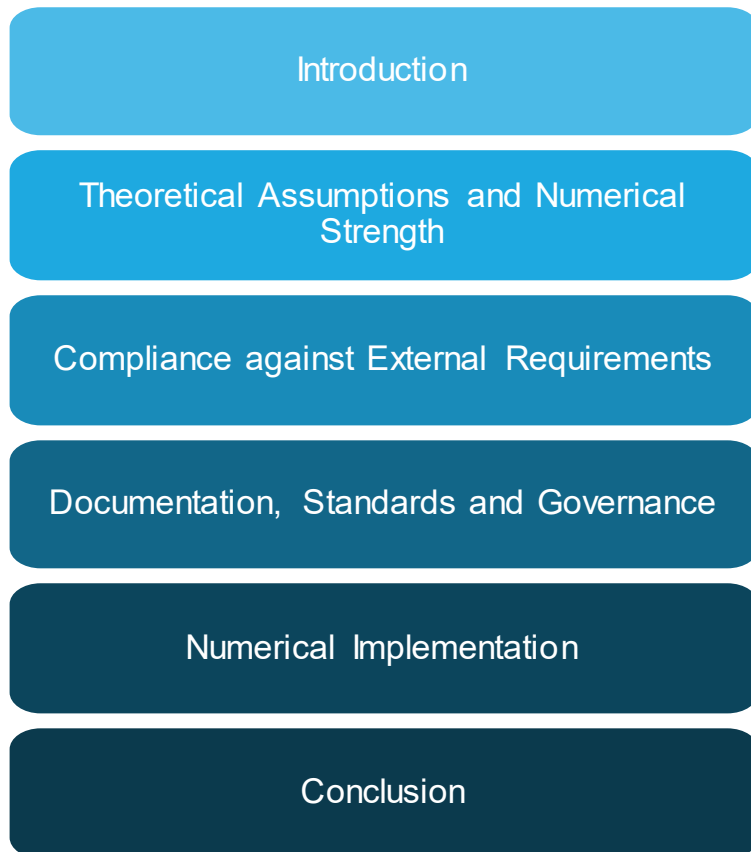
# Validation Reports Reflect Standard Processes, Content, and Formats

Typical IFRS 9 validation reporting example

## Broad Report Sections

## Subsections

## Detailed findings by Subsection



- » Supports regulatory filings
- » Replace/support Internal Audit reporting
- » Supports External Audit review
- » Provides decision support regarding assumption selection and segmentation approaches
- » Suitable for Board (F&A Committee) presentation
- » Starting point for next review cycle or business case development if major updates are indicated





Michael Denton,  
Director,  
[Michael.Denton@moodys.com](mailto:Michael.Denton@moodys.com)

Anamaria Pieschacon,  
Senior Economist,  
[Anamaria.Pieschacon@moodys.com](mailto:Anamaria.Pieschacon@moodys.com)

Mark Feeley,  
Research Director at Chartis,  
[mark@chartis-research.com](mailto:mark@chartis-research.com)



© 2019 Moody's Corporation, Moody's Investors Service, Inc., Moody's Analytics, Inc. and/or their licensors and affiliates (collectively, "MOODY'S"). All rights reserved.

**CREDIT RATINGS ISSUED BY MOODY'S INVESTORS SERVICE, INC. AND ITS RATINGS AFFILIATES ("MIS") ARE MOODY'S CURRENT OPINIONS OF THE RELATIVE FUTURE CREDIT RISK OF ENTITIES, CREDIT COMMITMENTS, OR DEBT OR DEBT-LIKE SECURITIES, AND MOODY'S PUBLICATIONS MAY INCLUDE MOODY'S CURRENT OPINIONS OF THE RELATIVE FUTURE CREDIT RISK OF ENTITIES, CREDIT COMMITMENTS, OR DEBT OR DEBT-LIKE SECURITIES. MOODY'S DEFINES CREDIT RISK AS THE RISK THAT AN ENTITY MAY NOT MEET ITS CONTRACTUAL FINANCIAL OBLIGATIONS AS THEY COME DUE AND ANY ESTIMATED FINANCIAL LOSS IN THE EVENT OF DEFAULT OR IMPAIRMENT. SEE MOODY'S RATING SYMBOLS AND DEFINITIONS PUBLICATION FOR INFORMATION ON THE TYPES OF CONTRACTUAL FINANCIAL OBLIGATIONS ADDRESSED BY MOODY'S RATINGS. CREDIT RATINGS DO NOT ADDRESS ANY OTHER RISK, INCLUDING BUT NOT LIMITED TO: LIQUIDITY RISK, MARKET VALUE RISK, OR PRICE VOLATILITY. CREDIT RATINGS AND MOODY'S OPINIONS INCLUDED IN MOODY'S PUBLICATIONS ARE NOT STATEMENTS OF CURRENT OR HISTORICAL FACT. MOODY'S PUBLICATIONS MAY ALSO INCLUDE QUANTITATIVE MODEL-BASED ESTIMATES OF CREDIT RISK AND RELATED OPINIONS OR COMMENTARY PUBLISHED BY MOODY'S ANALYTICS, INC. CREDIT RATINGS AND MOODY'S PUBLICATIONS DO NOT CONSTITUTE OR PROVIDE INVESTMENT OR FINANCIAL ADVICE, AND CREDIT RATINGS AND MOODY'S PUBLICATIONS ARE NOT AND DO NOT PROVIDE RECOMMENDATIONS TO PURCHASE, SELL, OR HOLD PARTICULAR SECURITIES. NEITHER CREDIT RATINGS NOR MOODY'S PUBLICATIONS COMMENT ON THE SUITABILITY OF AN INVESTMENT FOR ANY PARTICULAR INVESTOR. MOODY'S ISSUES ITS CREDIT RATINGS AND PUBLISHES MOODY'S PUBLICATIONS WITH THE EXPECTATION AND UNDERSTANDING THAT EACH INVESTOR WILL, WITH DUE CARE, MAKE ITS OWN STUDY AND EVALUATION OF EACH SECURITY THAT IS UNDER CONSIDERATION FOR PURCHASE, HOLDING, OR SALE.**

MOODY'S CREDIT RATINGS AND MOODY'S PUBLICATIONS ARE NOT INTENDED FOR USE BY RETAIL INVESTORS AND IT WOULD BE RECKLESS AND INAPPROPRIATE FOR RETAIL INVESTORS TO USE MOODY'S CREDIT RATINGS OR MOODY'S PUBLICATIONS WHEN MAKING AN INVESTMENT DECISION. IF IN DOUBT YOU SHOULD CONTACT YOUR FINANCIAL OR OTHER PROFESSIONAL ADVISER.

ALL INFORMATION CONTAINED HEREIN IS PROTECTED BY LAW, INCLUDING BUT NOT LIMITED TO, COPYRIGHT LAW, AND NONE OF SUCH INFORMATION MAY BE COPIED OR OTHERWISE REPRODUCED, REPACKAGED, FURTHER TRANSMITTED, TRANSFERRED, DISSEMINATED, REDISTRIBUTED OR RESOLD, OR STORED FOR SUBSEQUENT USE FOR ANY SUCH PURPOSE, IN WHOLE OR IN PART, IN ANY FORM OR MANNER OR BY ANY MEANS WHATSOEVER, BY ANY PERSON WITHOUT MOODY'S PRIOR WRITTEN CONSENT.

CREDIT RATINGS AND MOODY'S PUBLICATIONS ARE NOT INTENDED FOR USE BY ANY PERSON AS A BENCHMARK AS THAT TERM IS DEFINED FOR REGULATORY PURPOSES AND MUST NOT BE USED IN ANY WAY THAT COULD RESULT IN THEM BEING CONSIDERED A BENCHMARK.

All information contained herein is obtained by MOODY'S from sources believed by it to be accurate and reliable. Because of the possibility of human or mechanical error as well as other factors, however, all information contained herein is provided "AS IS" without warranty of any kind. MOODY'S adopts all necessary measures so that the information it uses in assigning a credit rating is of sufficient quality and from sources MOODY'S considers to be reliable including, when appropriate, independent third-party sources. However, MOODY'S is not an auditor and cannot in every instance independently verify or validate information received in the rating process or in preparing the Moody's publications.

To the extent permitted by law, MOODY'S and its directors, officers, employees, agents, representatives, licensors and suppliers disclaim liability to any person or entity for any indirect, special, consequential, or incidental losses or damages whatsoever arising from or in connection with the information contained herein or the use of or inability to use any such information, even if MOODY'S or any of its directors, officers, employees, agents, representatives, licensors or suppliers is advised in advance of the possibility of such losses or damages, including but not limited to: (a) any loss of present or prospective profits or (b) any loss or damage arising where the relevant financial instrument is not the subject of a particular credit rating assigned by MOODY'S.

To the extent permitted by law, MOODY'S and its directors, officers, employees, agents, representatives, licensors and suppliers disclaim liability for any direct or compensatory losses or damages caused to any person or entity, including but not limited to by any negligence (but excluding fraud, willful misconduct or any other type of liability that, for the avoidance of doubt, by law cannot be excluded) on the part of, or any contingency within or beyond the control of, MOODY'S or any of its directors, officers, employees, agents, representatives, licensors or suppliers, arising from or in connection with the information contained herein or the use of or inability to use any such information.

NO WARRANTY, EXPRESS OR IMPLIED, AS TO THE ACCURACY, TIMELINESS, COMPLETENESS, MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE OF ANY CREDIT RATING OR OTHER OPINION OR INFORMATION IS GIVEN OR MADE BY MOODY'S IN ANY FORM OR MANNER WHATSOEVER.

Moody's Investors Service, Inc., a wholly-owned credit rating agency subsidiary of Moody's Corporation ("MCO"), hereby discloses that most issuers of debt securities (including corporate and municipal bonds, debentures, notes and commercial paper) and preferred stock rated by Moody's Investors Service, Inc. have, prior to assignment of any rating, agreed to pay to Moody's Investors Service, Inc. for ratings opinions and services rendered by it fees ranging from \$1,000 to approximately \$2,700,000. MCO and MIS also maintain policies and procedures to address the independence of MIS's ratings and rating processes. Information regarding certain affiliations that may exist between directors of MCO and rated entities, and between entities who hold ratings from MIS and have also publicly reported to the SEC an ownership interest in MCO of more than 5%, is posted annually at [www.moody's.com](http://www.moody's.com) under the heading "Investor Relations — Corporate Governance — Director and Shareholder Affiliation Policy."

Additional terms for Australia only: Any publication into Australia of this document is pursuant to the Australian Financial Services License of MOODY'S affiliate, Moody's Investors Service Pty Limited ABN 61 003 399 657 AFSL 336969 and/or Moody's Analytics Australia Pty Ltd ABN 94 105 136 972 AFSL 383569 (as applicable). This document is intended to be provided only to "wholesale clients" within the meaning of section 761G of the Corporations Act 2001. By continuing to access this document from within Australia, you represent to MOODY'S that you are, or are accessing the document as a representative of, a "wholesale client" and that neither you nor the entity you represent will directly or indirectly disseminate this document or its contents to "retail clients" within the meaning of section 761G of the Corporations Act 2001. MOODY'S credit rating is an opinion as to the creditworthiness of a debt obligation of the issuer, not on the equity securities of the issuer or any form of security that is available to retail investors.

Additional terms for Japan only: Moody's Japan K.K. ("MJKK") is a wholly-owned credit rating agency subsidiary of Moody's Group Japan G.K., which is wholly-owned by Moody's Overseas Holdings Inc., a wholly-owned subsidiary of MCO. Moody's SF Japan K.K. ("MSFJ") is a wholly-owned credit rating agency subsidiary of MJKK. MSFJ is not a Nationally Recognized Statistical Rating Organization ("NRSRO"). Therefore, credit ratings assigned by MSFJ are Non-NRSRO Credit Ratings. Non-NRSRO Credit Ratings are assigned by an entity that is not a NRSRO and, consequently, the rated obligation will not qualify for certain types of treatment under U.S. laws. MJKK and MSFJ are credit rating agencies registered with the Japan Financial Services Agency and their registration numbers are FSA Commissioner (Ratings) No. 2 and 3 respectively.

MJKK or MSFJ (as applicable) hereby disclose that most issuers of debt securities (including corporate and municipal bonds, debentures, notes and commercial paper) and preferred stock rated by MJKK or MSFJ (as applicable) have, prior to assignment of any rating, agreed to pay to MJKK or MSFJ (as applicable) for ratings opinions and services rendered by it fees ranging from JPY125,000 to approximately JPY250,000,000.

MJKK and MSFJ also maintain policies and procedures to address Japanese regulatory requirements.