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Marvelous Model Risk Management
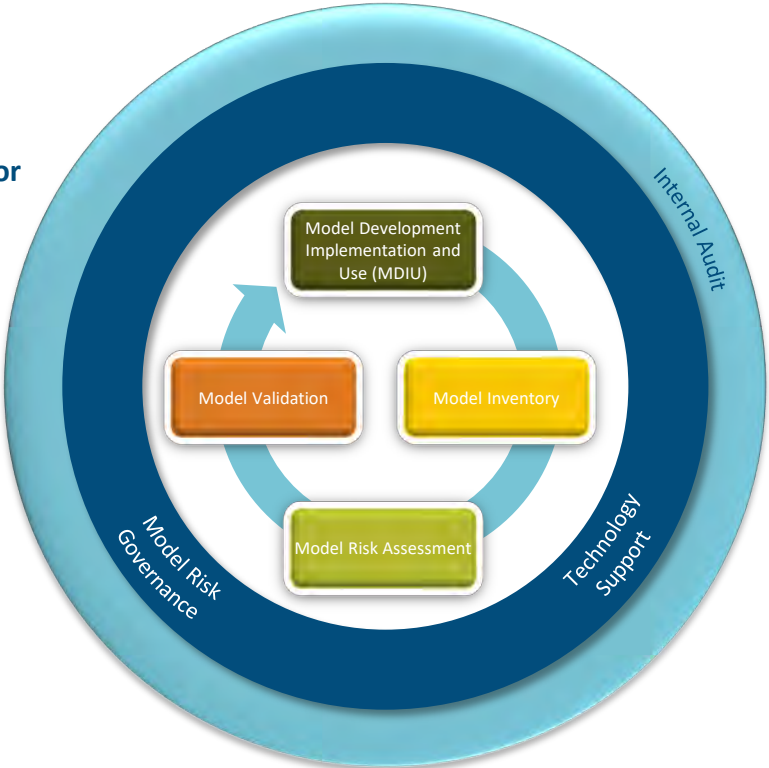
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SOCIETY OF
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Model Risk Management Program

A robust **Model Risk Management (MRM) program** supports an integrated, comprehensive solution and provides a practical approach for mitigating model risk.

Drivers of Changes

1. General growth in number of models used

2. Structure growing in complexity and the implementation of tools for consolidation

3. Desire for accurate earning forecast for business strategy and planning

4. Increasing data sources

5. Increased use of advanced technology and big data. e.g. predictive models for underwriting; machine learning tools

6. Demands from Board for improved risk management on non-core models e.g. pricing model

7. Regulatory changes such as moving away from LIBOR, LDTI, PBR, are necessitating MRM changes

Roles within MRM

1

**1ˢᵗ Line of Defense
(Model owners, developers, users)**

- Develop the model
- Implement and operate the model
- Monitor model performance
- Manage model changes
- Monitor model usage
- Complete model inventory
- Collaborate with 2nd LoD on maintenance of model inventory, risk assessment and model validation
- Collaborate with 3rd LoD on providing control evidences

2

**2ⁿᵈ Line of Defense
(Model Risk Management)**

- Establish policies and standards
- Manage model inventory
- Perform model risk assessment
- Perform independent model validation
- Report to Board and senior management
- Monitor quality of adherence to MRM policies

3

**3ʳᵈ Line of Defense
(Internal audit)**

- Monitors adherences to control processes and standards
- Provides an independent assessment of the first and second lines of defense

Benefits of MRM

Benefits of MRM

1. Consistency in mode definition

2. Consistency in risk definition, risk assessment, and risk management

3. Inherent risk is quantified

4. Ability to track all models in use and their information e.g. owner, validation status

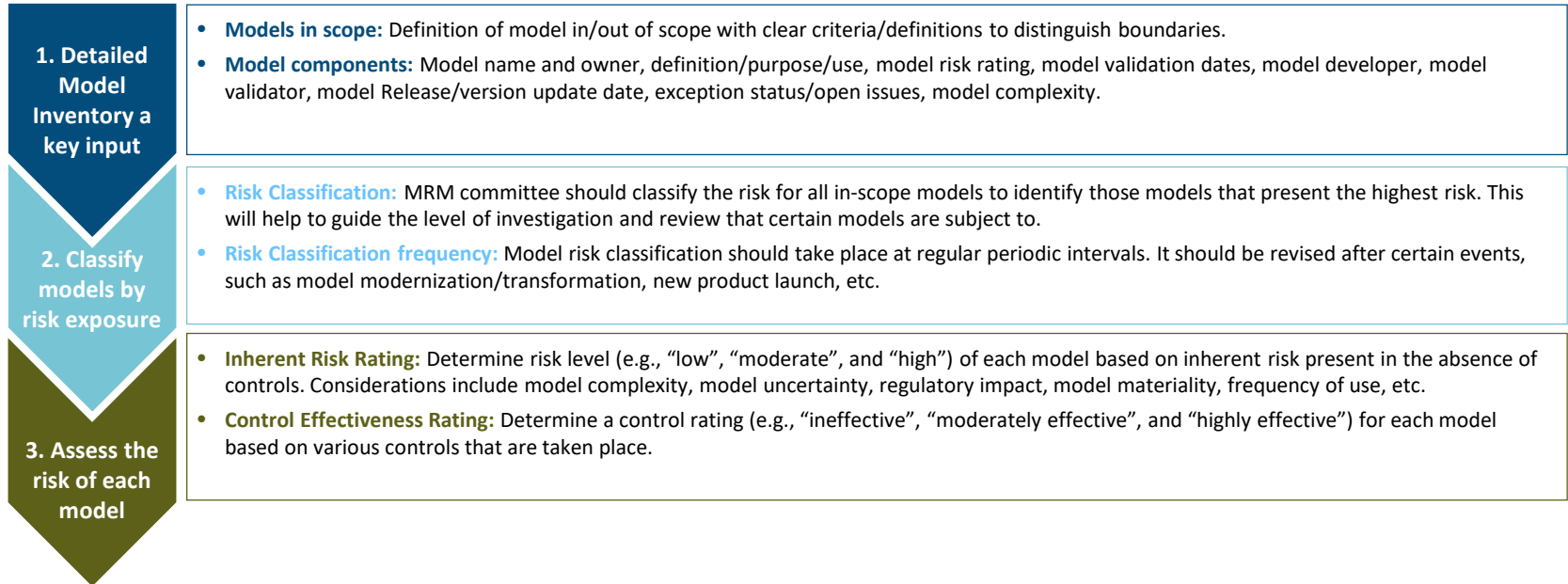5. Models are classified such that their treatment is appropriate and proportional

6. Collaboration between business units to manage risk

Model Risk Assessment

Following on from the establishment of a complete model inventory, insurers can embark on a model risk assessment.

1. Detailed Model Inventory a key input	• **Models in scope:** Definition of model in/out of scope with clear criteria/definitions to distinguish boundaries. • **Model components:** Model name and owner, definition/purpose/use, model risk rating, model validation dates, model developer, model validator, model Release/version update date, exception status/open issues, model complexity.
2. Classify models by risk exposure	• **Risk Classification:** MRM committee should classify the risk for all in-scope models to identify those models that present the highest risk. This will help to guide the level of investigation and review that certain models are subject to. • **Risk Classification frequency:** Model risk classification should take place at regular periodic intervals. It should be revised after certain events, such as model modernization/transformation, new product launch, etc.
3. Assess the risk of each model	• **Inherent Risk Rating:** Determine risk level (e.g., "low", "moderate", and "high") of each model based on inherent risk present in the absence of controls. Considerations include model complexity, model uncertainty, regulatory impact, model materiality, frequency of use, etc. • **Control Effectiveness Rating:** Determine a control rating (e.g., "ineffective", "moderately effective", and "highly effective") for each model based on various controls that are taken place.

Model Risk Assessment (continued)

The outcome of a risk assessment is used to classify the models into high, medium or low.
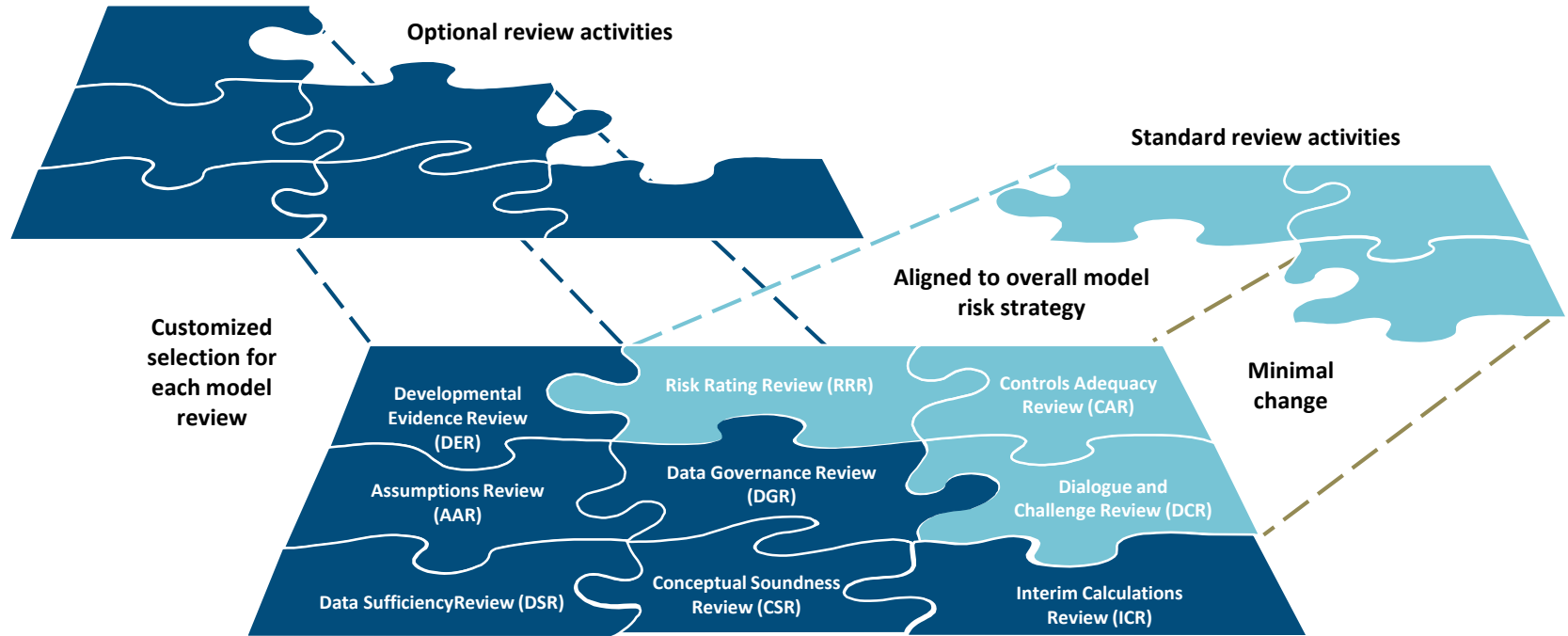
Below are two examples of the aggregation mechanism of criteria that results in a heat map-based model score.

Risk score – Impact & probability mapping

Severity										
50.0	5	10	15	20	25	30	35	40	45	50
45.0	4.5	9	13.5	18	22.5	27	31.5	36	40.5	45
40.0	4	8	12	16	20	24	28	32	36	40
35.0	3.5	7	10.5	14	17.5	21	24.5	28	31.5	35
30.0	3	6	9	12	15	18	21	24	27	30
25.0	2.5	5	7.5	10	12.5	15	17.5	20	22.5	25
20.0	2	4	6	8	10	12	14	16	18	20
15.0	1.5	3	4.5	6	7.5	9	10.5	12	13.5	15
10.0	1	2	3	4	5	6	7	8	9	10
5.0	10.00%	20.00%	30.00%	40.00%	50.00%	60.00%	70.00%	80.00%	90.00%	100.0%

Probability of occurrence

Red	High Risk	Amber	Moderate Risk	Green	Low risk Score

Rating (1-Low, 3-High)

	1	2	3	
Model Complexity			X	
Model Uncertainty	X			
Regulatory impact			X	
Model materiality		X		
Frequency of use		X		
Total	1	4	6	11/15

Types of Model Validation

Being able to customize the mix of standard and optional review elements is a powerful tool to ensure the organization is maximizing the value-add potential of the model risk function.

Optional review activities

Standard review activities

Aligned to overall model risk strategy

Customized selection for each model review

Minimal change

Developmental Evidence Review (DER)

Risk Rating Review (RRR)

Controls Adequacy Review (CAR)

Assumptions Review (AAR)

Data Governance Review (DGR)

Dialogue and Challenge Review (DCR)

Data SufficiencyReview (DSR)

Conceptual Soundness Review (CSR)

Interim Calculations Review (ICR)

Quality of an Effective MRM

Expanding authority of CRO

Embedded culture of model risk management and model governance

Clear lines of accountability, responsibility and communication among MRM

Consistent standards and processes

Clear definition of model vs. model component vs. tool

Covers the risk management measures in regards to the entire model life cycle

Knowledgeable resources

Robust data management

Room for flexibility

A Vision for Model Risk Management – The Early Stages of Development

Building a Model Risk Framework

- VISION – To create a comprehensive Model Risk Framework that works for Prudential
- Regulatory Environment – SIFI Designation
  - Federal Reserve's Supervisory Letter SR 11-7 guidance on Model Risk Management
  - Vision not blurred by the SIFI designation
- Developing a New Risk Language
  - What is a Model?
  - Model Components
  - Education
- Model Control Office
  - Building an Inventory of Models
  - Risk Assessing our Models
  - Launching our policies and standards
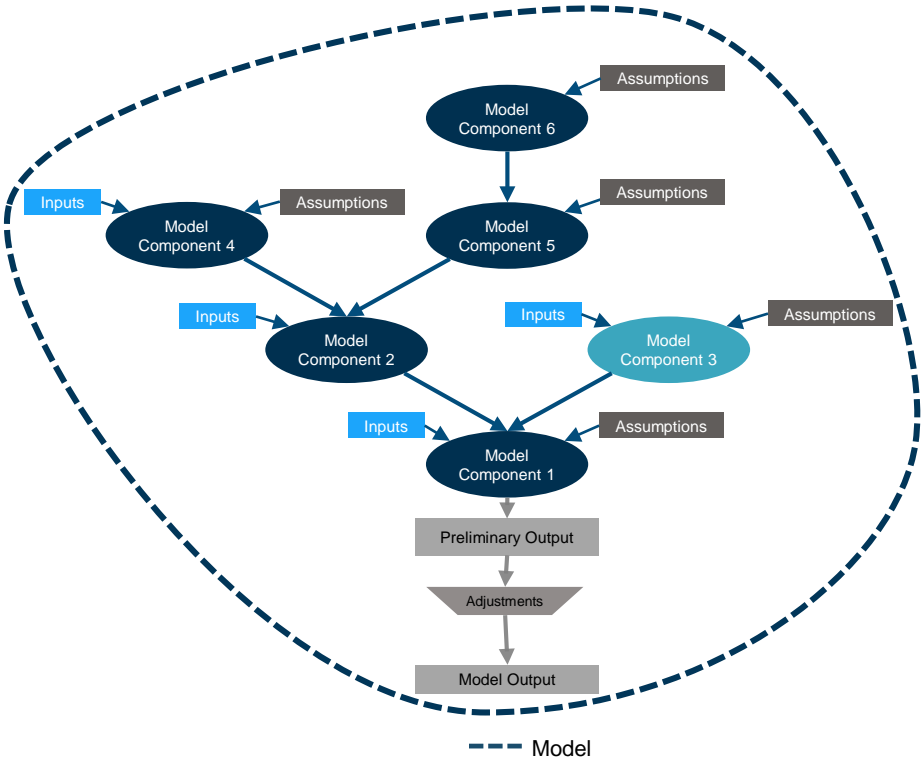- Building out a 4 – Year Review Plan
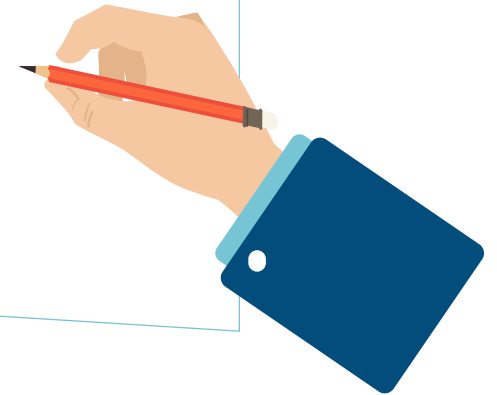
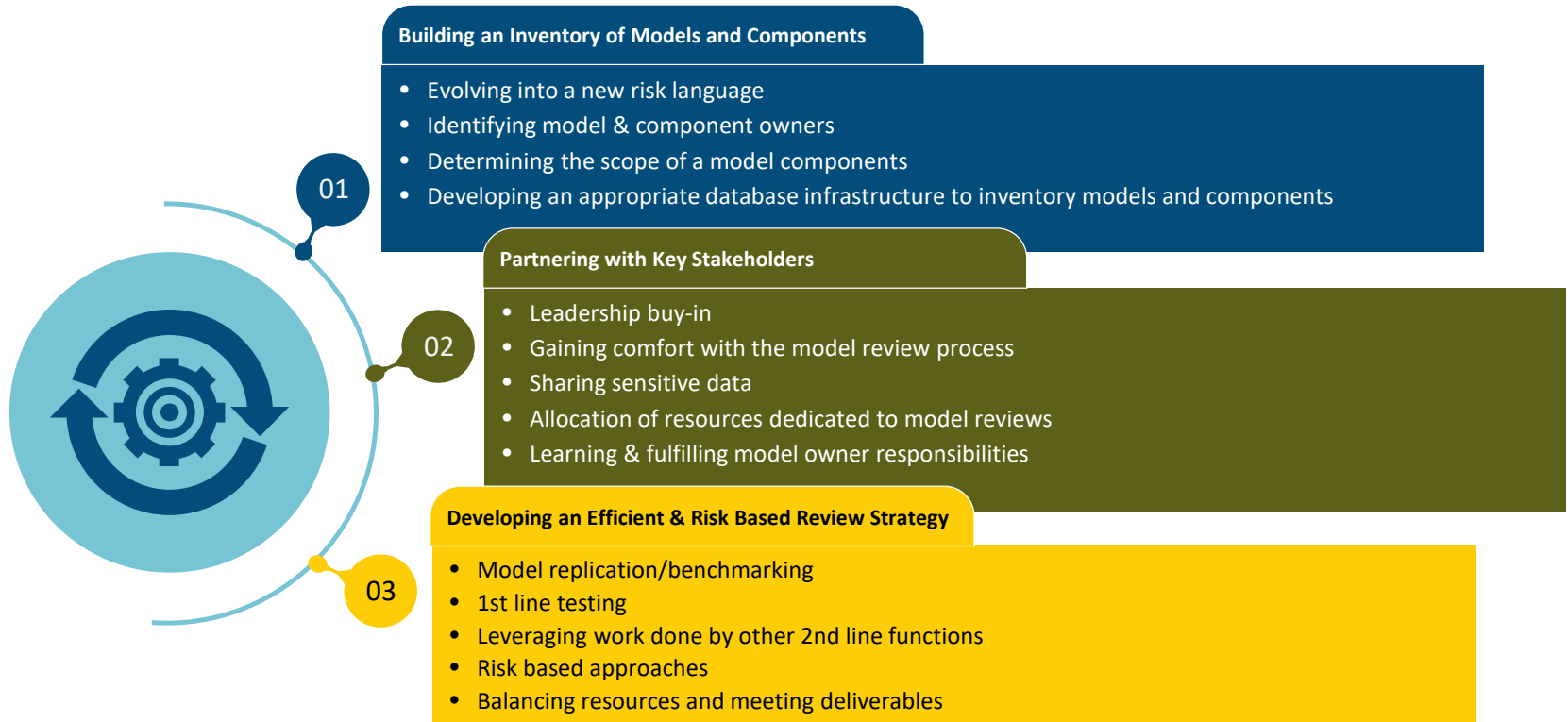# Model Risk Management Framework – Process-Oriented Models

Model

A quantitative method, system, or approach used to calculate or estimate value or risk that impacts Prudential's financial statements and/or assists in decision-making. A model consists of three fundamental elements: (a) inputs and/or assumptions, (b) calculation routines, and (c) outputs and their adjustments. Models transform given inputs and/or assumptions into outputs with some degree of complexity and uncertainty.
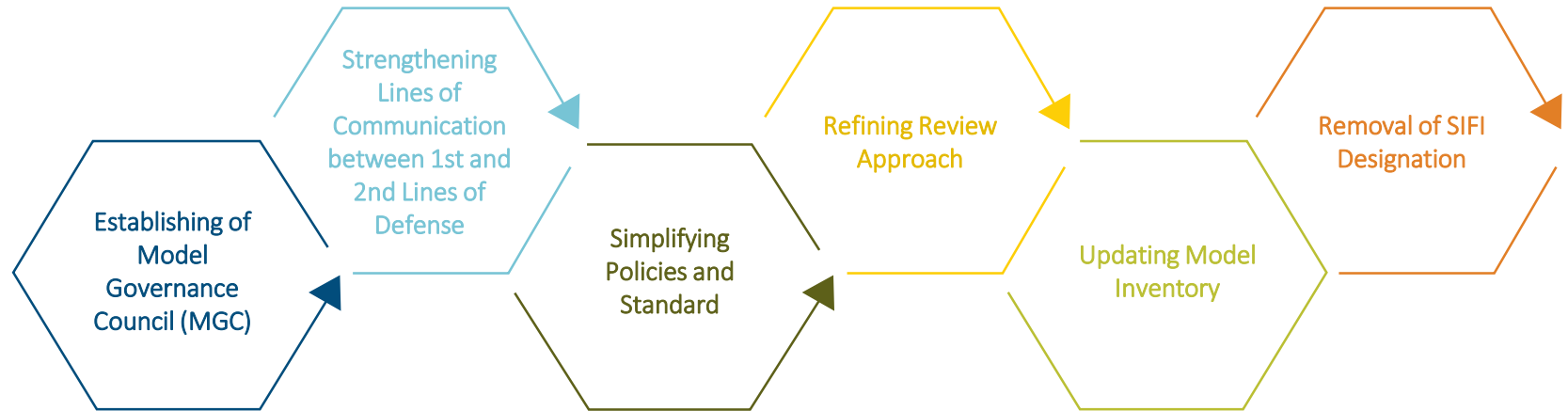
Model Component

A separately identifiable computation (or set of computations) within a model that generates output(s) from input(s) and/or assumption(s). A model component should be identified as a "shared model component" if it is used by more than one model.

Implementation Challenges – Transforming Culture and Building Consensus

Building an Inventory of Models and Components

- Evolving into a new risk language
- Identifying model & component owners
- Determining the scope of a model components
- Developing an appropriate database infrastructure to inventory models and components

01

Partnering with Key Stakeholders

- Leadership buy-in
- Gaining comfort with the model review process
- Sharing sensitive data
- Allocation of resources dedicated to model reviews
- Learning & fulfilling model owner responsibilities

02

Developing an Efficient & Risk Based Review Strategy

- Model replication/benchmarking
- 1st line testing
- Leveraging work done by other 2nd line functions
- Risk based approaches
- Balancing resources and meeting deliverables

03

Journey to Success – Learning and Refining

Establishing of Model Governance Council (MGC)

Strengthening Lines of Communication between 1st and 2nd Lines of Defense

Simplifying Policies and Standard

Refining Review Approach

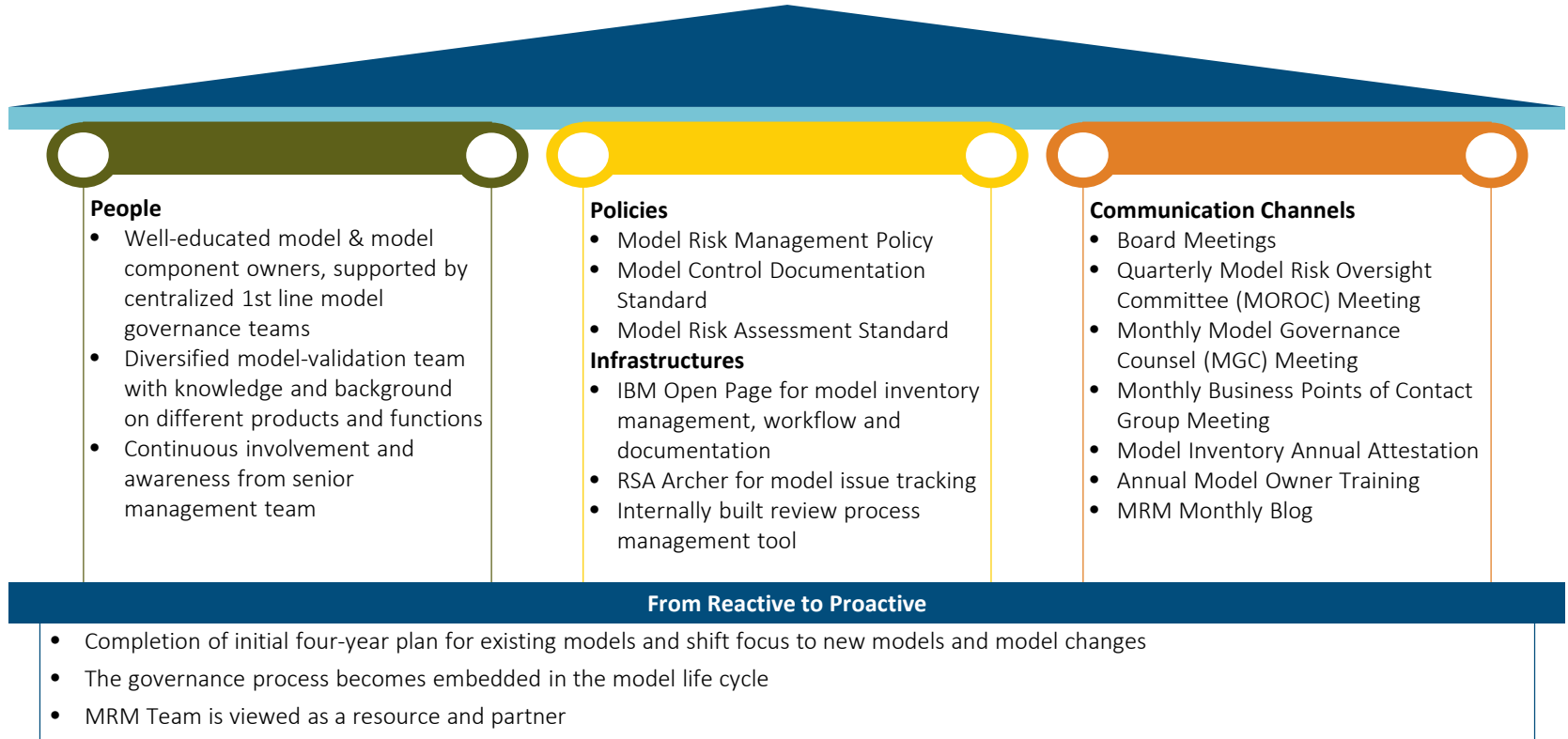**Updating Model Inventory**

Removal of SIFI Designation

- Driving senior stakeholder engagement through establishing risk committee consisting of Chief Actuary, Chief Risk Officer, Head of Actuarial Centers of Excellence & Head of Enterprise Risk Strategy, Head of Model Risk
- Forum for discussion, by senior management and subject matter experts, of issues related to model risk governance and control
- MGC responsible for providing guidance on review findings
- Brought Key Stakeholders together from Actuarial, Finance and Risk

- Establishing Points of contact within the business which oversee Business Unit's Model Risk Management Activities
- Finance Model Excellence (FMX)
- Actuarial Model Management and Controls (AMC)

- Engaging Industry experts on alternatives to benchmarking/ replication
- Output Analytics
- Leverage Existing Oversight Functions

- No change to the vision of the model risk framework
- Increased focus on Model Risk objectives

Transformation of MRM Environment

People
- Well-educated model & model component owners, supported by centralized 1st line model governance teams
- Diversified model-validation team with knowledge and background on different products and functions
- Continuous involvement and awareness from senior management team

Policies
- Model Risk Management Policy
- Model Control Documentation Standard
- Model Risk Assessment Standard

Infrastructures
- IBM Open Page for model inventory management, workflow and documentation
- RSA Archer for model issue tracking
- Internally built review process management tool

Communication Channels
- Board Meetings
- Quarterly Model Risk Oversight Committee (MOROC) Meeting
- Monthly Model Governance Counsel (MGC) Meeting
- Monthly Business Points of Contact Group Meeting
- Model Inventory Annual Attestation
- Annual Model Owner Training
- MRM Monthly Blog

From Reactive to Proactive
- Completion of initial four-year plan for existing models and shift focus to new models and model changes
- The governance process becomes embedded in the model life cycle
- MRM Team is viewed as a resource and partner

Shifting Focus – Model Changes

New Wave of Model Changes

- Residual Risk largely reduced and remains modestly higher than targeted, largely due to new waves of material model changes
- Regulatory Reforms
  - FASB Long-Duration Targeted Improvements
  - Variable Annuity Statutory Reserve and Capital Reform
  - London Inter-bank Offered Rate (LIBOR) Transition
  - International Financial Reporting Standards (IFRS) updates
  - Impacted Models accounted for ~30% of overall Model Inventory
- Projection Capability Expansion
- Platform/System Conversions
- Issue Remediation

Controls

- Exception
- Re-Affirmation/Provisional Approval
- Re-Affirmation/Re-review/Recertification
- Periodic Assessment

Planning & Prioritization

- Models will be dynamically prioritized
- Challenges
  - Timeline changes for regulatory reforms
  - Constantly changing corporate environment leads to model ownership changes
  - Coordination with other governance/control functions

Risk Mitigation

- First Line
  - Documentation of model changes based on version controls
  - Testing design focusing on changes along with high quality testing summary
  - Ongoing Performance Monitoring
- Second Line
  - Fill the gaps of model changes & framework evolvement
  - Perform cross-product-line reviews

Future of Model Risk

Extended Scope

- Expansion of Model Risk Framework to cover additional intended uses, including models using advanced techniques
- Involving applications of Machine Learning and Artificial Intelligence, which may be complex, lack transparency, rely on significant judgment, be unstable, or be subject to errors or biases

Application of advanced techniques in MRM Work

- Automation of MRM processes
- Automation of Ongoing Performance Monitoring

OUR MISSION

✦

The mission of the association is to facilitate the financial security of its members, associates and their families through provision of a full range of highly competitive financial products and services; in so doing, USAA seeks to be the provider of choice for the military community.

THE USAA STANDARD

✦

- Keep our membership and mission first
- Live our core values: Service, Loyalty, Honesty, Integrity
- Be compliant and manage risk
- Build trust and help each other succeed
- Embrace diversity and be purposefully inclusive
- Innovate and build for the future

USAA Enterprise Model Risk Management Program

Department and Enterprise Model Portfolio Composition

- Department of 60+ professionals
- 6 validation teams
- 2 governance teams
- Relevant guidance:
  - Federal Reserve SR 11-7
  - Upcoming: ASOP 56

- Validation Teams Support:
  - Property & Casualty companies
  - Federal Savings Bank
  - Life Insurance Company and Investment Services Company
  - Enterprise Finance and Capital
  - Marketing
  - Fraud and Anti-Money Laundering

USAA Life and Investments Model Validation Team

Team Composition and Portfolio of Models

- Team of ~ 5 Validators
- Backgrounds in:
- Actuarial Science
- Economics
- Mathematics
- Operations Research
- Physics
- Statistics

- Portfolio of ~ 50 Models
  - Accelerated Underwriting
  - Actuarial – ALM, Pricing, Valuation
  - Actuarial Assumption Models
  - Applications – Member/Rep Facing
  - Asset Cashflow Projection
  - Capital Models including Catastrophes (pandemic, war, etc.)
  - Financial Forecast and Accounting
  - Machine Learning
  - Natural Language Processing
  - New Business Distributions
  - Risk Metrics

Lessons Learned

Actuarial Modeling and Model Risk Management

Variable Annuity Valuation

- Valuation and Capital – IFRS, AG43 & C3P2
- Stochastic projection and run-time constraints
- Modeling Hedging – Mapping, Basis Risk, Volume, and Frequency

Life and Annuity Modeling
- Multi-purpose AXIS models used by ALM, Capital, Pricing, Risk, and Valuation
- Model Governance and Change Management – difficult but important
- Analogies with IT: Dev/Prod/Test, regular release cycles, blackouts, etc.

Model Risk Management

- Balancing trust and accountability between the SLOD and the FLOD
- Requirements: Internal vs. External
- Culture: Banking vs. Insurance industry norms

USAA®

Emerging Trends – Machine Learning Applications

- **Need: Group-level standards, strategy, and oversight of machine learning initiatives.**
- **Compliance considerations and reputation risk**
- **Benchmarking and back testing of NLP models**
- **Drawing model borders for machine learning models**

Neural Networks
- Accelerated Underwriting

General Predictive Models
- Questionnaire Imputation

Natural Language Processing
- Text Feedback Processing
- Compliance Checks