Session 87PD: Model Validation and Governance in the PBR World

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2018 VALUATION ACTUARY SYMPOSIUM

AUGUST 28, 2018

Erzhe Zhang, FSA MAAA

Model Validation and Governance in the PBR World

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Model validation key objectives

Discover findings

- Assess the accuracy and completeness of actuarial models
- Quantify and organize findings into categories such as error, simplification, or limitation

Understand risk drivers

- Identify common root causes across the findings
- Possible causes: control failure, simplification, pre-existing issue from legacy/pricing, or workaround due to complexity or limitation

Remediate findings and mitigate risk

- Prioritize findings for remediation based on quantification and category
- Mitigate risk based on root cause

Model validation roadmap

Assemble key stakeholders	• Governance and risk committees, senior management, pricing team, valuation model owners, IT/admin system support, and auditors • Gather sources of truth such as approved assumption documentation, product specifications, policy forms and admin extracts
Prioritize validation	• Inventory actuarial models in scope • Rank for risk exposure based on inforce size, complexity, or known findings
Divide validation into parallel workstreams	• Product features and assumptions • Model calculations • Reinsurance • Model output compilation
Testbed of policies and scenarios	• Identify testbed policies to cover major product features and assumptions • Choose test scenarios to trigger dynamic behavior and simplify CTE/GPVAD validation

Model validation in a PBR world
Universal Life example

		PBR VALIDATION ROADMAP
Outer loop	An aggregate cash flow projection based on best estimate assumptions and starting assets	• Standard model validation techniques • Bifurcate liability validation and asset validation
Net premium reserve (NPR)	A seriatim formulaic calculation using specified CSO mortality tables, prescribed lapses and prescribed valuation interest rates	• Seriatim replication using policy testbed, assumptions specific to type of guarantee (specified premium versus shadow account) - Level premium for main guarantee (solve to maturity) - Calculate level and fully funded premiums for secondary guarantee (duration dependent) - Calculate net single premium at annual nodes and interpolate - Apply reinsurance credit
Deterministic reserve (DR)	An aggregate gross premium reserve developed as the present value of pretax liability cash flows at discount rates, using a prescribed scenario	• Build on outer loop validation and swap in “inner loop” assumptions • Validate at required pivot points: transition from best estimate to prudent assumption, present value, and results aggregation
Stochastic reserve (SR)	An aggregate reserve calculation using an asset liability model developed as a starting asset amount plus the greatest present value of accumulated deficiencies over a range of stochastic scenarios, with the SR set at the 70th conditional tail expectation (CTE)	• Build on DR validation and use test scenarios • Simplify validation with flat scenarios or static assumptions (e.g., turn off dynamic premium). Then, validate using SR scenario and dynamic assumptions • For each test scenario, calculate GPVAD and CTE70 at required pivot points

Beyond actuarial models

1 **Admin data and inforce creation**

2 **Scenario generation and asset modeling**

3 **Downstream tools (e.g., Excel tools)**

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Assumption Governance in PBR World

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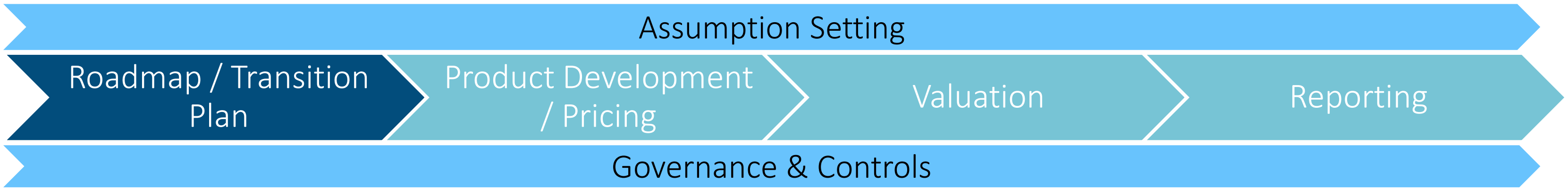
Ernst & Young, LLP

Agenda

- PBR: Longer Term Challenges
- Assumption Governance
- Assumption Monitoring
- Assumption Validation

Longer Term Challenges



Product Development / Pricing

- Product mix and design
- Reinsurance/hedging
- Modeling capabilities
- Model governance (VM-G)

Assumption Setting (pricing)

- Assumptions related to pricing (assets and liabilities)
- Assumption governance

Assumption Setting (valuation)

- Assumptions related to valuation (refinement)
- Coordination between pricing and valuation assumptions

Valuation

- Stat/Tax, Gross/Net of Reinsurance
- Post valuation processing
- Reserve levels and volatility by product
- Uncertainty in guidance (NY regulations)

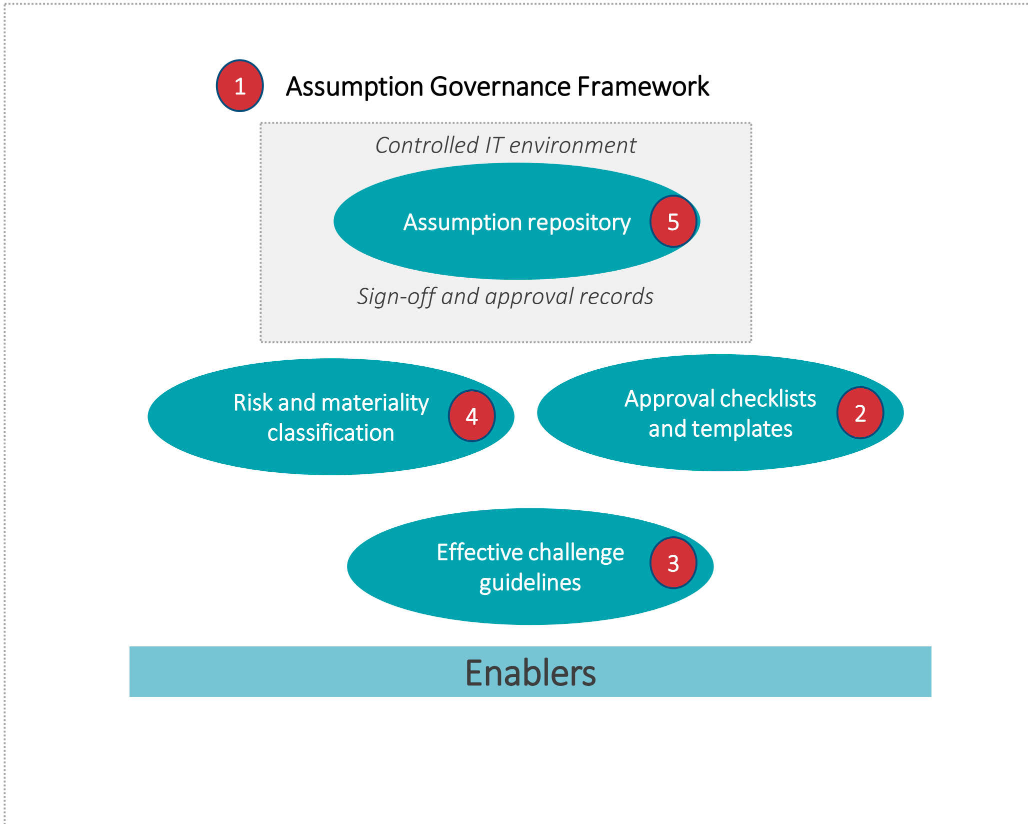
Reporting

- Attribution analyses/explaining results
- Experience tracking (VM-50/51)
- Transition period
- VM-31

Assumption Governance

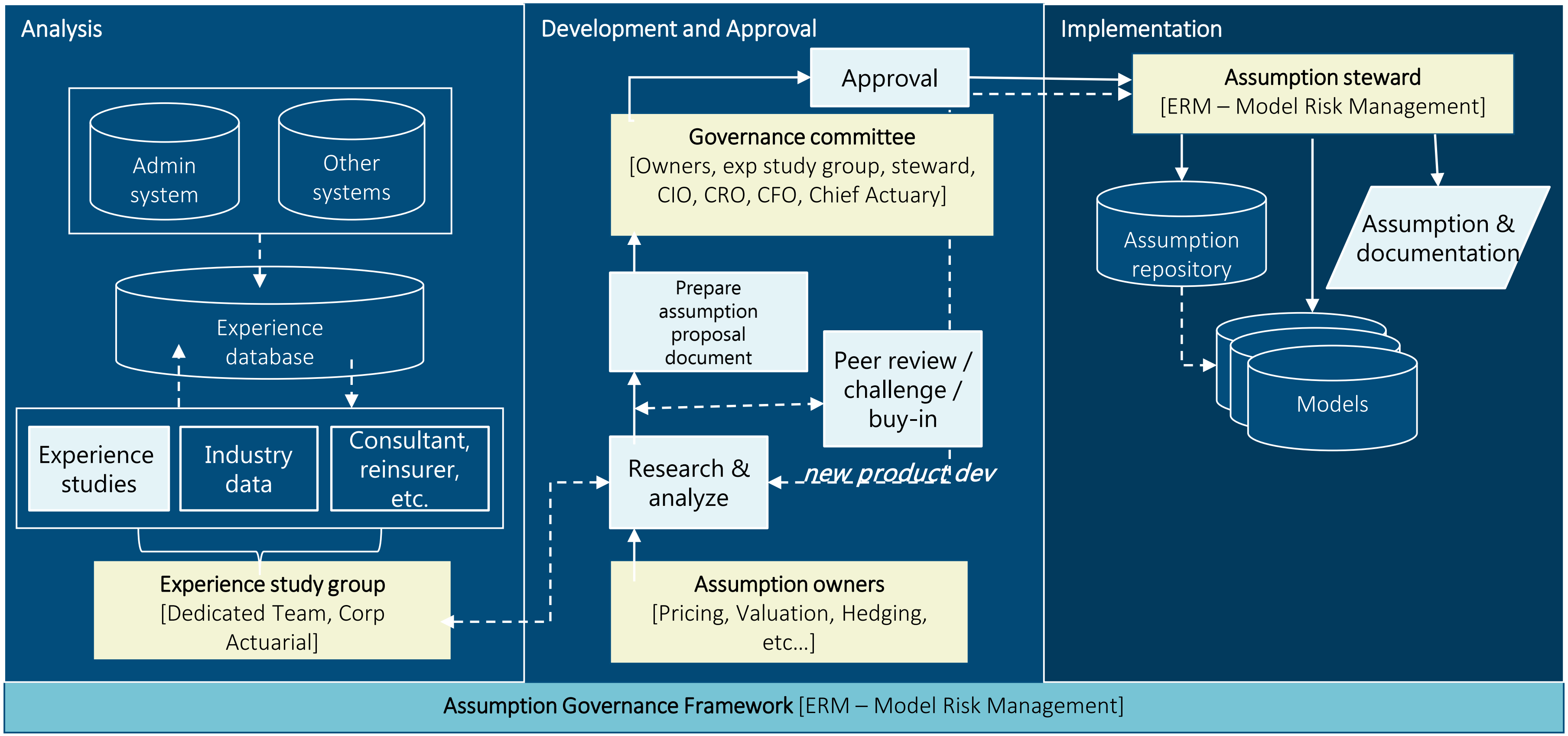
- Governance framework
- Checks and controls on experience study process
- Single source of truth
- Consistency across all use-cases
- Focus on both best-estimate and margins
- Challenges with forecasting

Framework To Support Policy Development



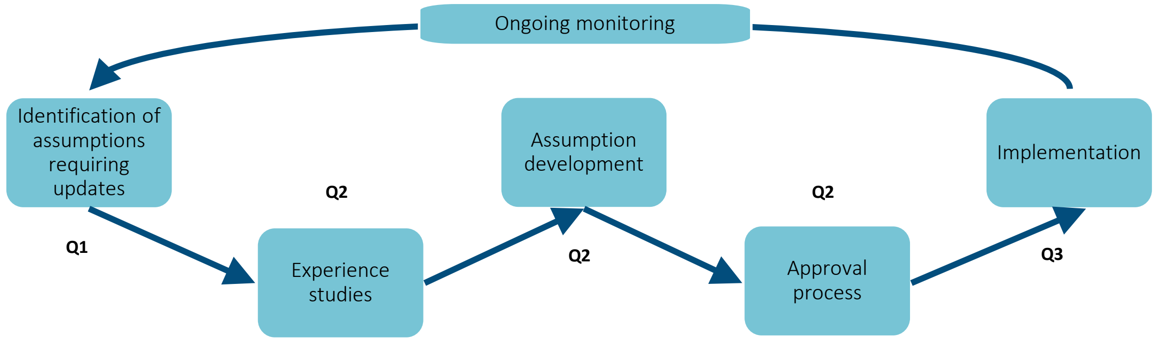
	Leading Practices
1	Governance policy clearly defines roles and responsibilities of each party involved. The policy also defines appropriate processes for establishing assumptions that are fit for purpose in a controlled business environment.
2	Clear distinction is placed between assumption updates (e.g., economic inputs) from judgment changes (e.g., policyholder behavior). Policy defines the review / acceptance framework accordingly. Policy also differentiates protocols and requirements for each reporting basis and risk rating bands.
3	Governance framework allows for an effective challenge of proposed assumptions. The challenge may be from Chief Actuary/Appointed Actuary, senior business leaders, and risk functions. Challenges are documented.
4	Comprehensive inventory of assumptions is maintained and is regularly refreshed. Assumptions are sometimes risk assessed and rated based on characteristics such as materiality, credibility of underlying data, and use of judgment.
5	Assumptions are stored in assumption repository. The assumptions may be stored in a model-ready format (e.g., ALFA, PolySystems format). There are clearly defined owners, users, and reviewers, and access to the repository is controlled and documented

Hypothetical Governance Framework Structure



Ongoing Assumption Monitoring

- Assumptions are subject to review based on their risk classification. Ongoing monitoring of known and emerging risks is a key element in the assumption framework.
- Formal thresholds establish a chain of events that trigger the assumption review process, which results in 'Assumption Unlocking'.
- Timeliness of ongoing monitoring becomes essential to ensure that there is enough time allotted to conduct the procedures set out in the assumption framework.



- **PBR Application:** "The company shall review, and update as needed, the company experience data described in Subsection 9.C.2.b, whether based on actual experience or data from other sources, at least every three years. If updated experience becomes available prior to the end of three years since the last review or update, which alters the company's expected mortality for the mortality segments in a significant manner and such impact is expected to continue into the future, the company shall reflect the changes implied by the updated data in the current year." VM-20 section 9

Methods for Setting Best Estimate Assumptions

Key items to address when setting best estimate assumptions

Sensitivity Analysis	▶ Sensitivity analysis could be used to determine the level of precision required in the modeling of each risk factor ▶ Guidance on balancing level of precision with amount of credible data ▶ Discussion of how sensitivity analysis is to be used in setting best estimate assumptions
Credibility	▶ Definition of how credibility should be measured (e.g. threshold for full credibility, aggregation level, metrics) ▶ Discussion of appropriate circumstances for use of industry data and the methods to blend such data with company experience
Advanced Analysis Techniques	▶ Assumptions that exhibit dynamic behaviour may be developed using techniques such as predictive analytics. ▶ Documentation of key variables and metrics used for such analysis
Planned Management Actions	▶ Framework for incorporating future management actions into model ▶ Guidance on developing assumptions that are not based on company experience nor industry data
Documentation	▶ Incorporate experience study results in annual actuarial assumption update ▶ Select certain experience studies for review each year to perform an in-depth review over data used, methods employed, and conclusions drawn.

PBR Application

- "Description of the method used to determine anticipated experience assumptions for each material risk factor, including the degree to which the assumptions are based on experience versus actuarial judgment or other factors, and the source of the experience." VM-31
- "An explanation of how the results of sensitivity tests and varying assumptions were used or considered in developing assumptions including a description of, results of, and action taken with respect to sensitivity tests performed." VM-31
- "The company shall examine the results of sensitivity testing to understand the materiality of prudent estimate assumptions on the modeled reserve." VM-20
- "Description of the method to determine the level of credibility for the company's mortality exposure period." VM-31

Validation of Assumptions

- Consistency with Valuation Manual
- Consistency with other sources/guidance (industry practice, ASOP, enterprise guidance)
- Compare assumption over time and across use-cases/models
- Compare against external benchmarks
- Peer review for judgment based assumptions
- Outcome based review, examples:
  - Assess against expected impacts based on results
  - Trend of results over time
  - Sensitivity analysis
  - Back-testing
  - Dynamic Validation
  - Waterfall analysis

Illustrative Waterfall Analysis

			NPR Reserve		Deterministic Reserve				Stochastic Reserve				Booked Reserve
					Best Estimate		With Margin		Best Estimate		With Margin		Max(NPR,SR,DR)
	Run Identifier		***Gross***	***Net***	***Gross***	***Net***	***Gross***	***Net***	***Gross***	***Net***	***Gross***	***Net***	***Net***
Prior Period Reserve	Prior Period Reserve		1800	900	2,000	1,000	3,000	1,500	2,020	1,010	3,030	1,516	**1,516**
Experience changes	Time decay	Natural change in reserve due to aging of policies	20	10	20	10	30	16	34	18	52	26	26
	Terminations	Impact from deaths, surrenders, and lapses	-100	-50	-100	-50	-150	-76	-76	-38	-114	-58	-58
	Reinsurance	Impact from new treaties, amendments, and termination of treaties	0	0	0	0	0	0	0	0	0	0	0
Economic assumption changes	Discount rate	Change in discount rate (net earned rate (DR), risk-free rates (SR))	0	0	300	150	450	226	200	100	300	150	150
	Asset changes	Changes in portfolio composition	0	0	-100	-50	-150	-76	-86	-44	-130	-64	-64
	Scenario update	Changes in rates and spreads	0	0	-150	-76	-226	-112	-142	-72	-214	-106	-106
	Reinvestment strategy	Impact from changes in (re)investment strategy	0	0	0	0	0	0	0	0	0	0	0
Actuarial assumption changes	Modeling	Model refinements	0	0	20	10	30	16	40	20	60	30	30
	Mortality	Changes in anticipated experience	0	0	200	100	300	150	204	102	306	154	154
	Mortality	Changes in credibility of company experience	0	0	0	0	-20	-14	0	0	-20	-14	-14
	Surrenders	Changes in anticipated experience	0	0	60	30	90	46	68	34	102	52	52
	Lapses	Changes in anticipated experience	0	0	100	50	150	76	114	58	172	86	86
	Lapses	Changes in quantification of margin	0	0	0	0	-10	-6	0	0	-12	-6	-6
	Expenses	Changes in anticipated experience	0	0	20	10	30	16	32	16	48	24	24
	Expenses	Changes in quantification of margin	0	0	0	0	-2	-2	0	0	-2	-2	-2
New business	New business	Additional reserves for new business	100	50	120	60	180	90	134	68	202	100	100
		Unexplained	0	0	-50	-26	-44	-16	-38	-20	-24	-6	-6
Current Period Reserve	Current Period Reserve		1,820	910	2,440	1,220	3,660	1,830	2,504	1,252	3,756	1,878	**1,878**

Prior Period Reserve	1,800	900	2,000	1,000	3,000	1,500	2,020	1,010	3,030	1,516	1,516
Experience changes	-80	-40	-80	-40	-120	-60	-42	-22	-64	-32	
Economic assumption changes	0	0	50	26	76	38	-28	-14	-42	-22	
Actuarial assumption changes	0	0	400	200	568	280	458	230	654	322	
New business	100	50	120	60	180	90	134	68	202	100	
Unexplained	0	0	-50	-26	-44	-16	-38	-20	-24	-6	
Total Change	20	10	440	220	660	330	484	242	726	364	364
Current Period Reserve	1,820	910	2,440	1,220	3,660	1,830	2,504	1,252	3,756	1,878	1,878

Attribution Elements Relevant to VM-20 Under Different Reporting Regimes

Summary of the relevance of attribution elements to VM-20 under different reporting regimes:

MCEV	AG 43	US GAAP	IFRS	CALM
• New business value • Expected existing business contribution • Operation variances • Change in assumptions • Economic variances • Non-operating variances	• Impact from equity market • Impact from interest rates • Impact from volatility • Inforce business impact • New business impact • Change in assumptions • Unexplained • Derivatives and hedging assets • Reinsurance	• Net premium approach liabilities • Multi-scenario approach liabilities • Normalized earnings • Reinsurance • Sensitivity analysis • Fair value disclosures	• Liability adequacy test • Sensitivity test • Reinsurance	• Supporting assets • New business value • Existing business contributions • Change in assumptions • Reinsurance • Sensitivity analysis

Model Governance

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Goals and Tools of Model Governance

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Goals of Model Governance

- Efficiency
- Consistency
- Validity
- Accuracy
- Applicability
- Audit Trail
- Confidence
- Compliance (e.g., VM-G)

Tools of Model Governance

Model Inventory

Authorization Policy and Process

Documentation

Culture

Model Inventory

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What to Include in Model Inventory

- Owners
- Purpose / Intended Use
- Limitations
- Statistics

Characteristics of a Model Inventory

Comprehensive

Collaborative

Used

Potential Model Inventory Statistics

Importance	Risk Level	Sizing
Platform	Runtime	Audience
	Work Cycle	

Benefits of a Model Inventory

Reduce Silos, Identify Redundancies	Prioritization of Model Improvements
Production Environment	Enterprise Snapshot of Model Risk
Improved Objectivity	Model Literacy

Authorization Policy and Process

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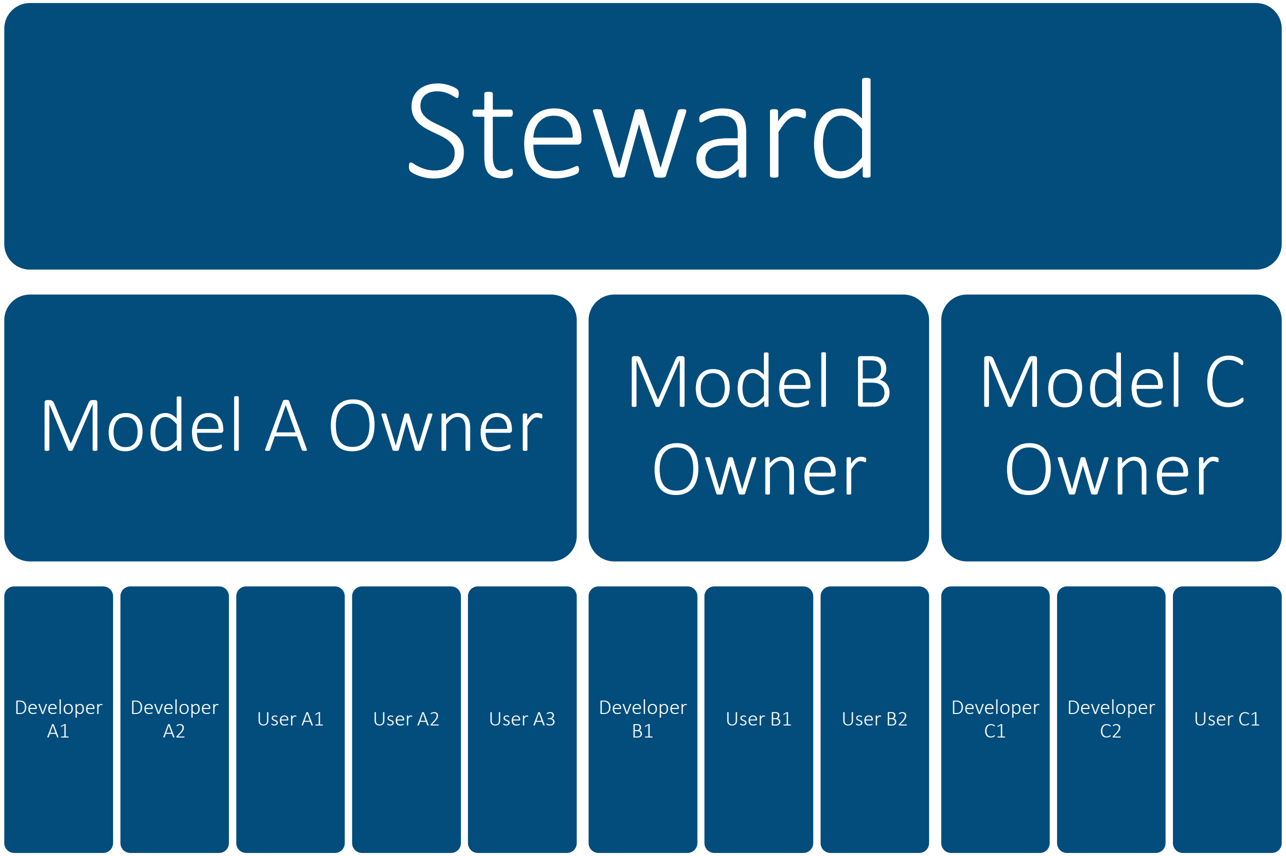
Benefits of Authorization Policy and Process

Efficiency	Validity
Accuracy	Applicability
Consistency	Confidence

Model Process Roles



Model Process Roles (Continued)

User

- Runs production models
- Can change model inputs
- Typically early in career
- Not necessarily an actuary

Developer

- Can change model code
- Runs are for testing purposes only
- Typically, a more experienced actuary

Model Process Roles (Continued)

Owner

- Oversees Users and Developers;
- Ultimately Responsible for Model Maintenance and Results
- Ensures Appropriateness of Model

Steward

- Gatekeeper
- Grants Appropriate Model Access
- Maintains Model Inventory
- Independent
- Monitors Effectiveness of Governance

Documentation

Documentation

Purpose	Limitations	Applicability
Authority	Library of Decisions	Model Change Process
Exceptions	Update Guide	Fresh Eyes

Culture

Cultural Aspects

Transparent

Educational

Collaborative

Early and Ongoing Expectations

Normalize

Share

Bureaucratic

Prescriptive

Retributive, “Gotcha!”

Defensiveness

Power Dynamics

But How…

Keys to Failure

- Top Down Stick versus Carrot
- Insufficient Infrastructure (need to TEACH people)
- One and Done
- FOCUS ON PROCESS

Keys to Success

- Inspire through Purpose
- Sustained Energy (triathlon vs. Sprint)
- Peripheral Expertise
- Agile Culture
- Learning Culture
- FOCUS ON PEOPLE

BCG, November 9, 2015, A Leader's Guide to Always On Transformation

Putting People First

Invisible fears, insecurity and anxiety in the face of change

Resistance is usually passive, invisible, and unconscious

Fixed Beliefs (Confirmation Bias)

HBR, June 25, 2018, Leaders Focus Too Much on Changing Policies, and Not Enough on Changing Minds

Putting People First (Continued)

What am I not seeing?	What else is true?
What is my responsibility in this situation?	How are my fears influencing my perspective?

HBR, June 25, 2018, Leaders Focus Too Much on Changing Policies, and Not Enough on Changing Minds

Governance of Governance

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Governance of Governance

How discovered

What procedures failed? Why?

Improvement Plan

Incidence Reporting

Where else?

Impact on risk score

Governance of Governance (Continued)

Upgrade & Enhancement Metrics

Runtime Statistics

Group Meeting Issues

Shift Roles

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