Catastrophe Model Validation

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SCOR

Agenda

➢ Validation Market Observations

➢ What is Business Led Validation?

➢ Tips from our recent North America Earthquake Validation

Catastrophe Validation – Market Observations

- Less gold-plating for a regulatory audience, more **business led validation**

- Consistent validation framework, applied efficiently

- Proportionate validation

- Leverage vendor validation

- More crowd-sourcing, less validation in a vacuum

- First principles approach to assess suitability of science and its implementation
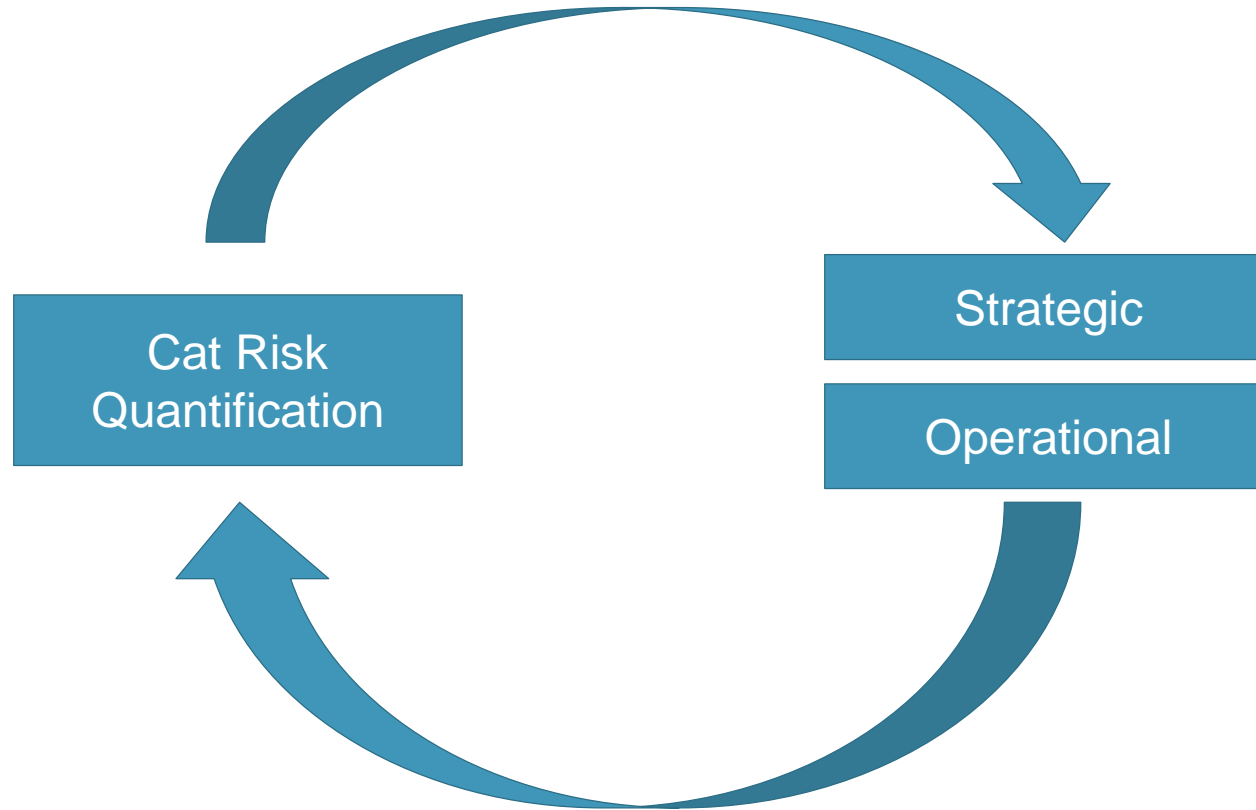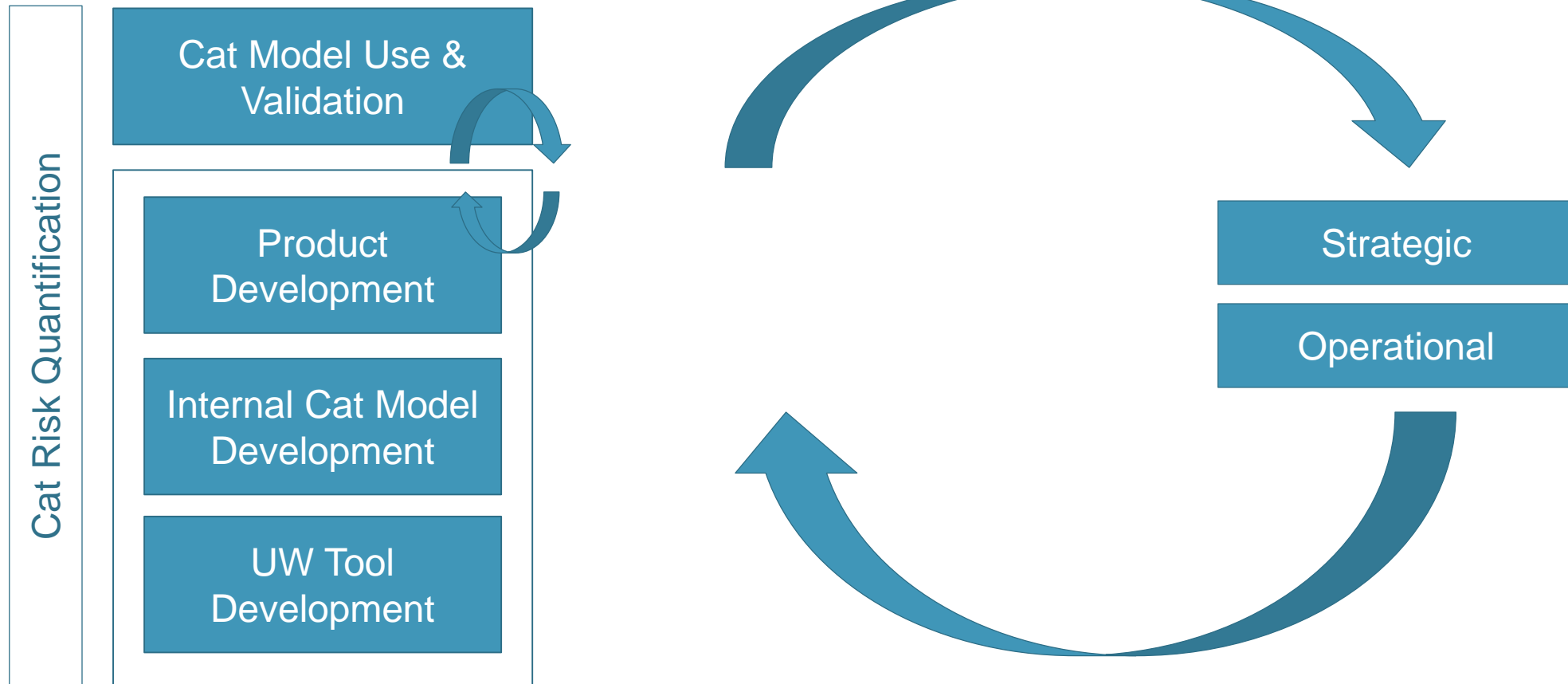
Business Led Validation

Validation Principles
Business Led Validation

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Validation Principles
Business Led Validation

Cat Risk Quantification

Cat Model Use & Validation

Product Development

Internal Cat Model Development

UW Tool Development

Strategic

Operational

Validation Principles
Business Led Validation

Cat Risk Quantification

Cat Model Use & Validation

Product Development

Internal Cat Model Development

UW Tool Development

Decision-Making

Operational

Capacity Management

Pricing

Event Response

Strategic

Capital Calibration

Retrocession Purchase
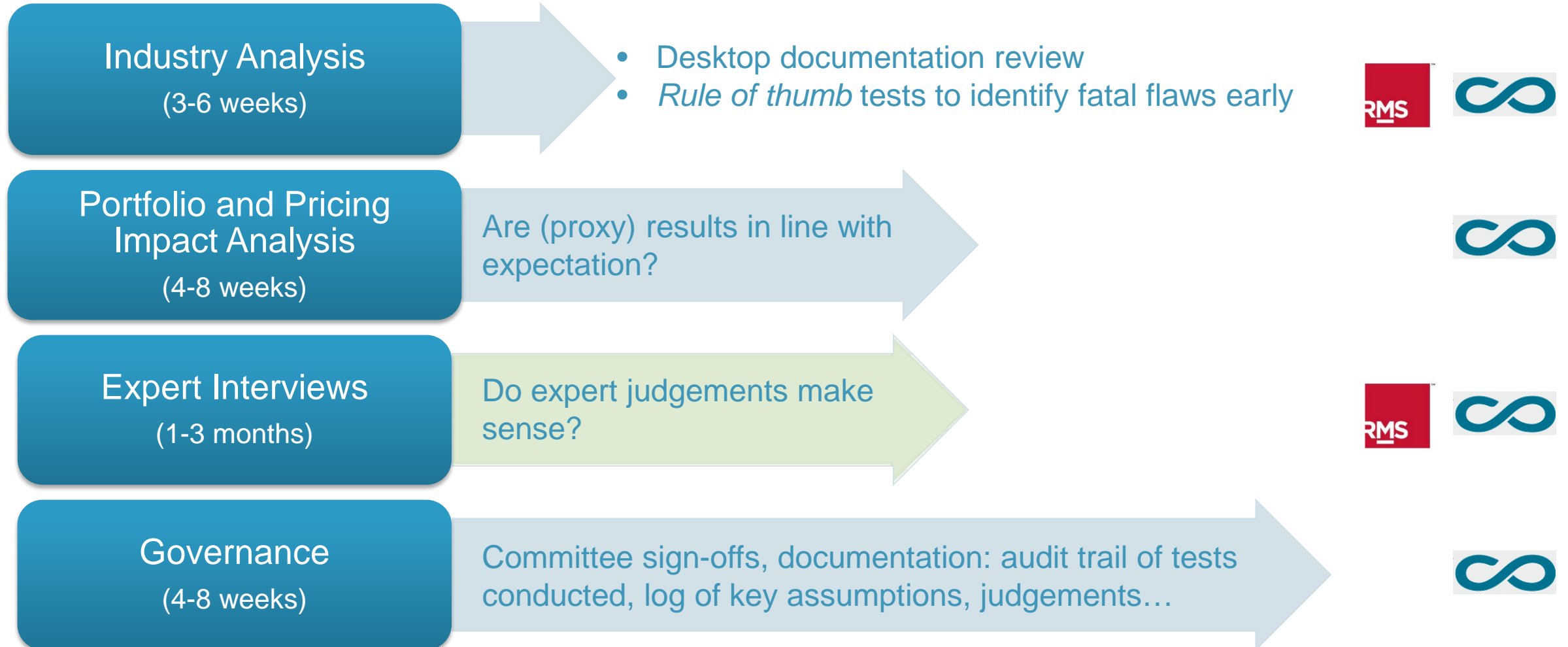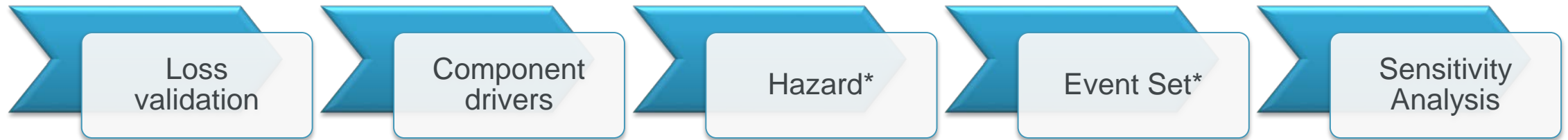
Business Planning

ILS Fund Management

Tips from a recent peak peril validation

Phased Validation

Depth of validation depends on scope of the vendor update and materiality of the region-peril

Industry Analysis
(3-6 weeks)

- Desktop documentation review
- *Rule of thumb* tests to identify fatal flaws early

Portfolio and Pricing Impact Analysis
(4-8 weeks)

Are (proxy) results in line with expectation?

Expert Interviews
(1-3 months)

Do expert judgements make sense?

Governance
(4-8 weeks)

Committee sign-offs, documentation: audit trail of tests conducted, log of key assumptions, judgements…

RMS

US Earthquake Validation
Approach

| Loss validation	Component drivers	Hazard*	Event Set*	Sensitivity Analysis

Topics / Tests chosen depends on the scope of vendor model update and materiality of region-peril. The aim is to identify a manageable list of key topics that the team can work through in a few weeks

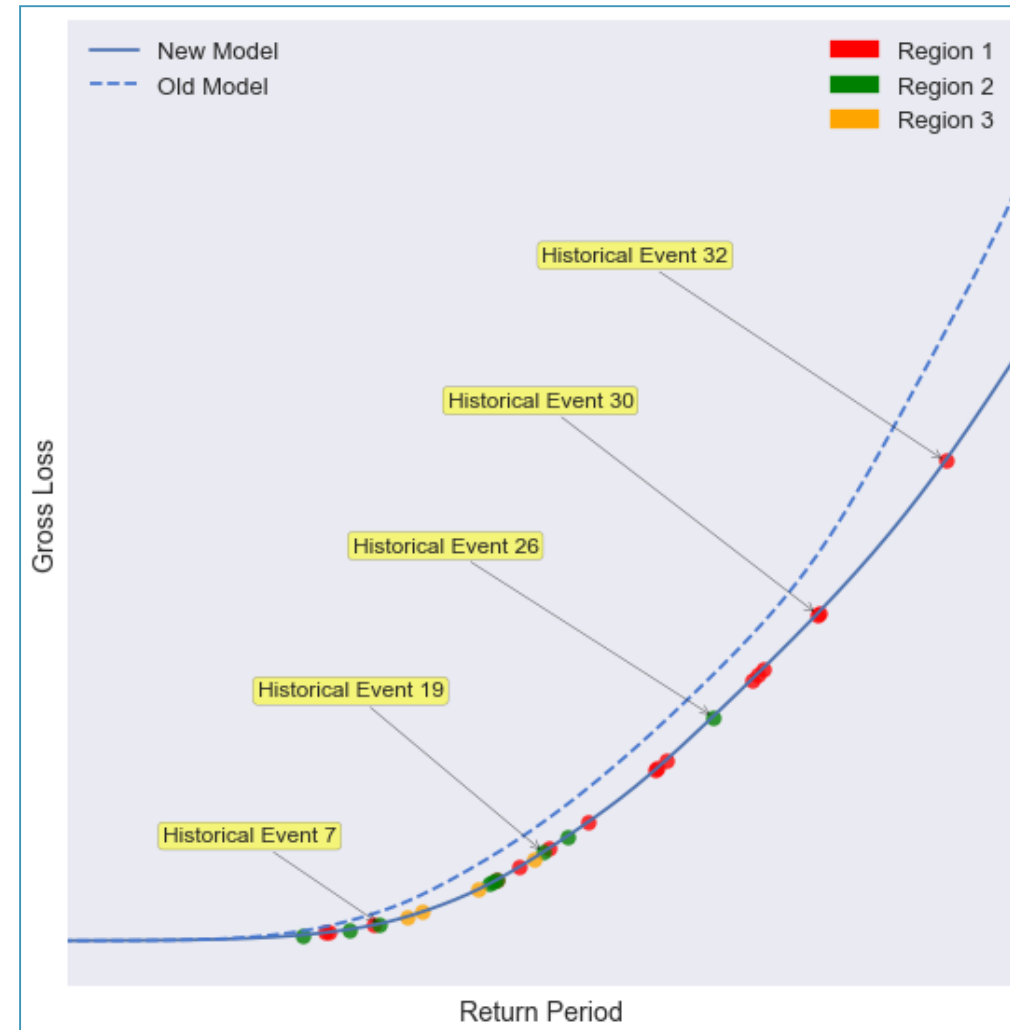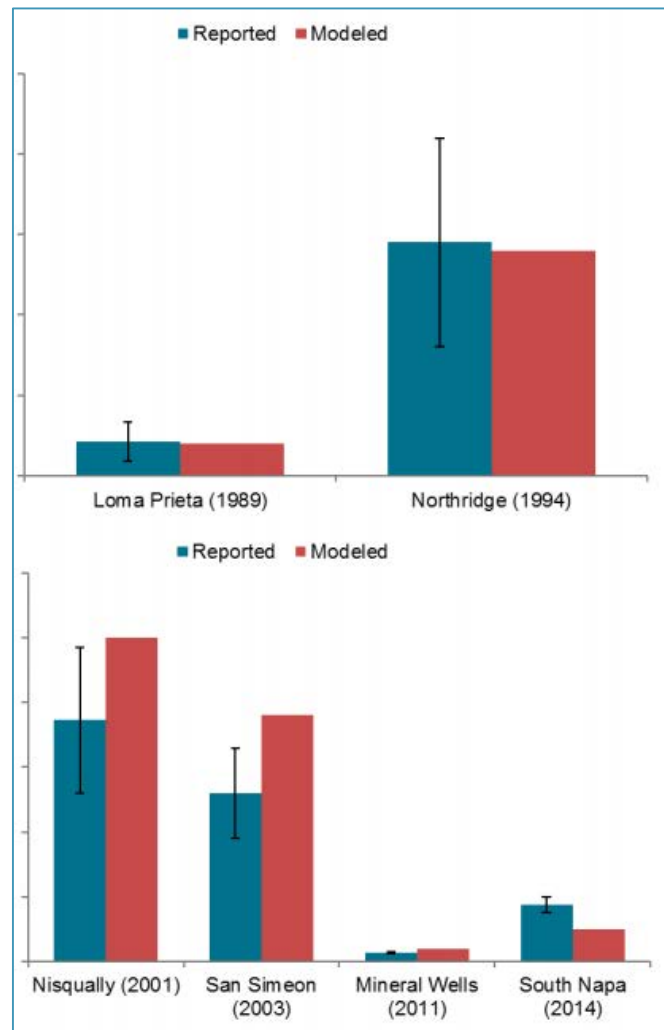Loss validation | Component drivers | Hazard* | Event Set* | Sensitivity Analysis
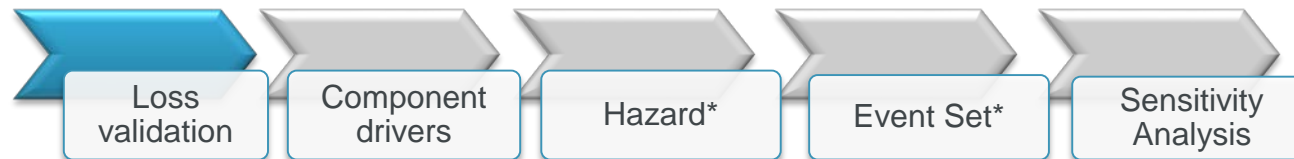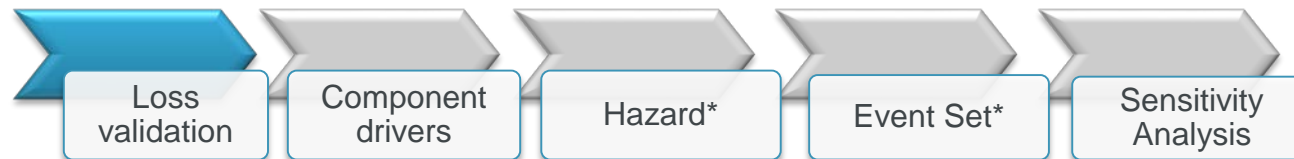
Back-testing

Are modelled losses in line with experience?

How does the implied (modelled) return period of events compare with expert expectations?
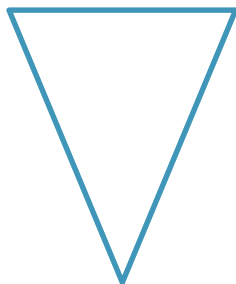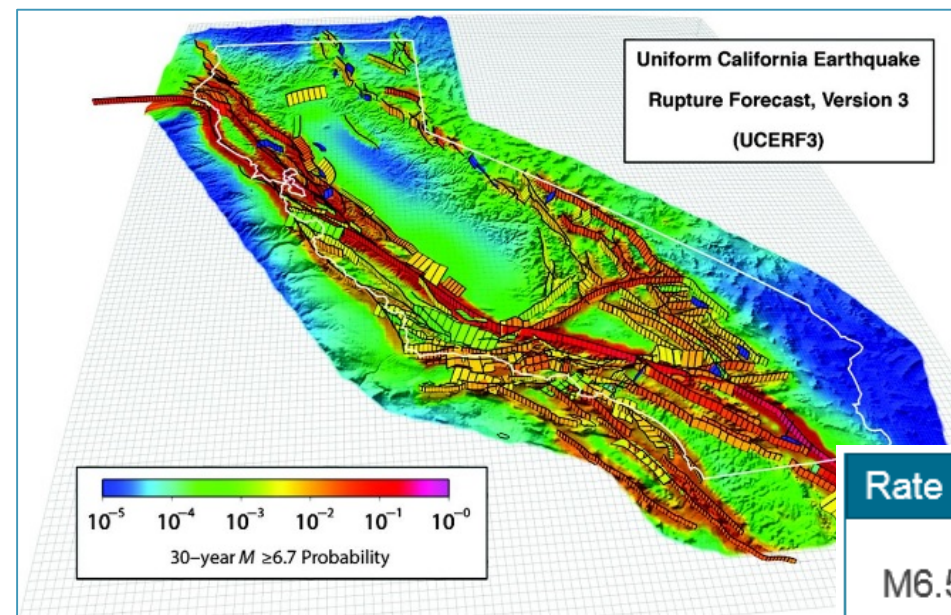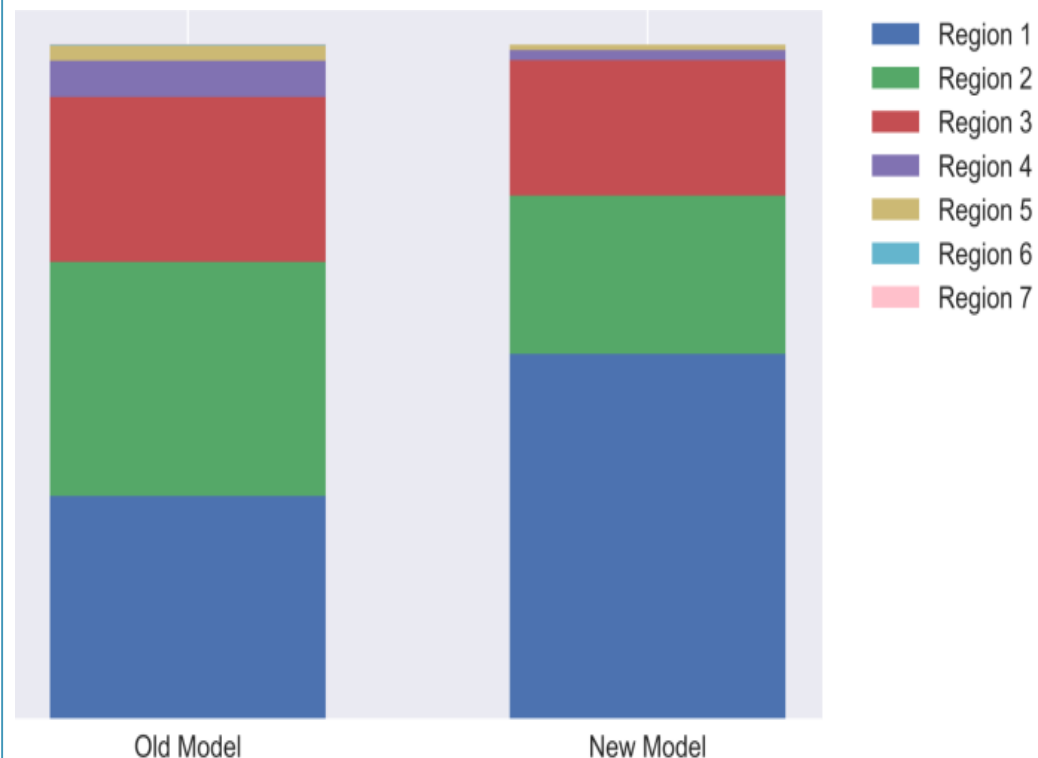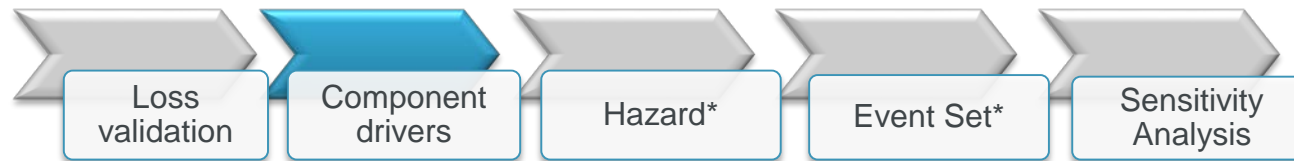
Industry
Portfolio
Contract
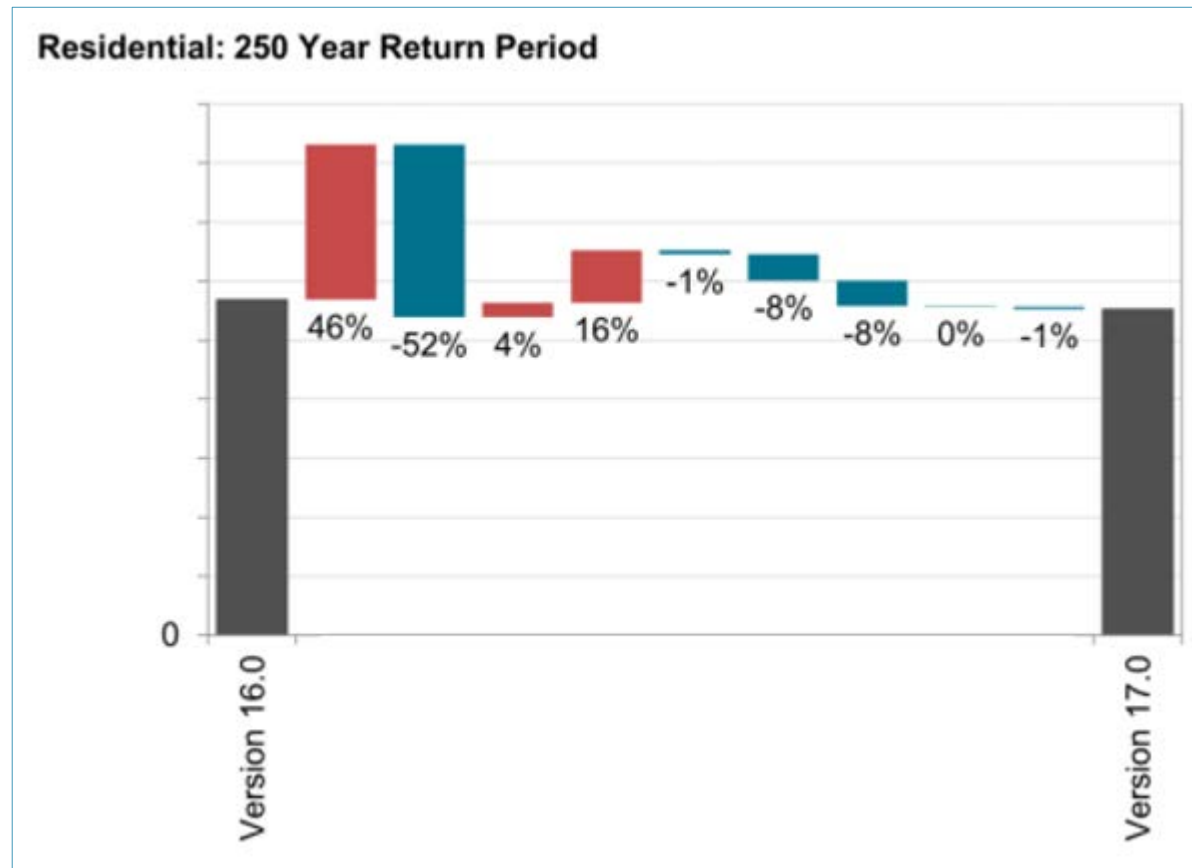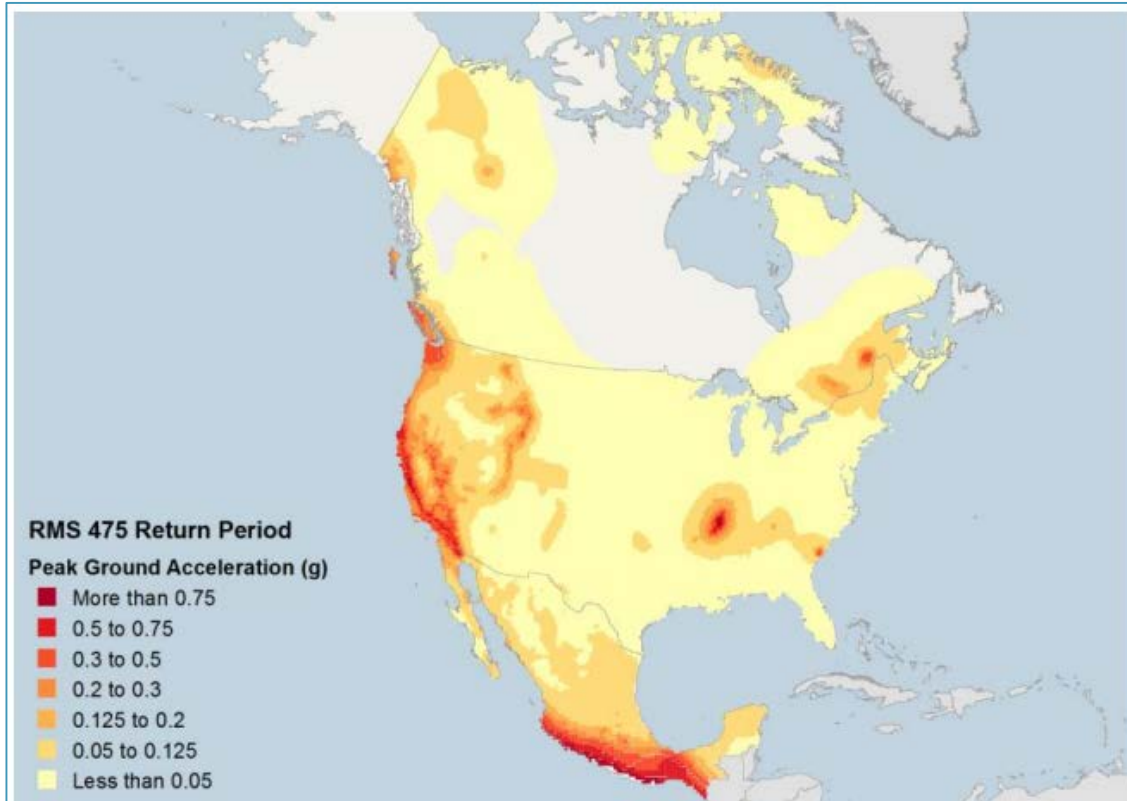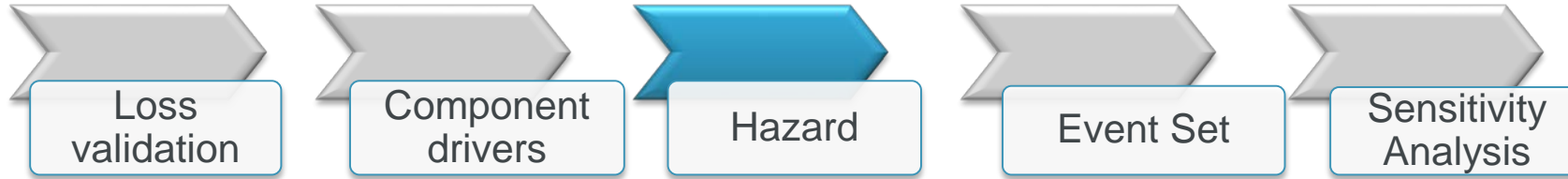
Vendors provide component attribution analysis that helps identify drivers of change arising from updates to model components such as:

- GMPEs*
- Seismic sources
- Amplification
- Secondary perils (PLA, liquefaction, landslide),
- Vulnerability,
- Soil

Residential: 250 Year Return Period

Version 16.0 — 46% -52% 4% 16% -1% -8% -8% 0% -1% — Version 17.0

*Ground Motion Prediction Equations

Loss validation → Component drivers → **Hazard** → Event Set → Sensitivity Analysis

RMS 475 Return Period
Peak Ground Acceleration (g)
- More than 0.75
- 0.5 to 0.75
- 0.3 to 0.5
- 0.2 to 0.3
- 0.125 to 0.2
- 0.05 to 0.125
- Less than 0.05

Comparison of 475-year PGA generated using:
A) RMS time-independent catalogue
B) USGS National Seismic Hazard Maps

Consider:
- Location of hazard hotspots
- Graduation of hazard
- Could be repeated at regional level for CA, PNW and NM
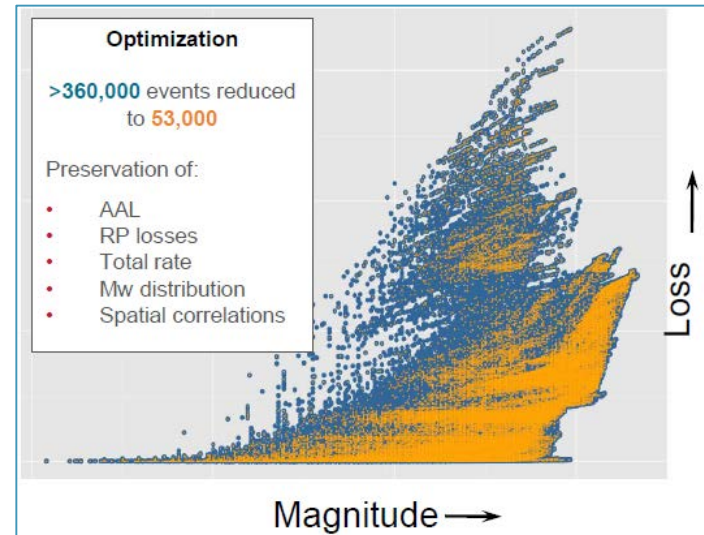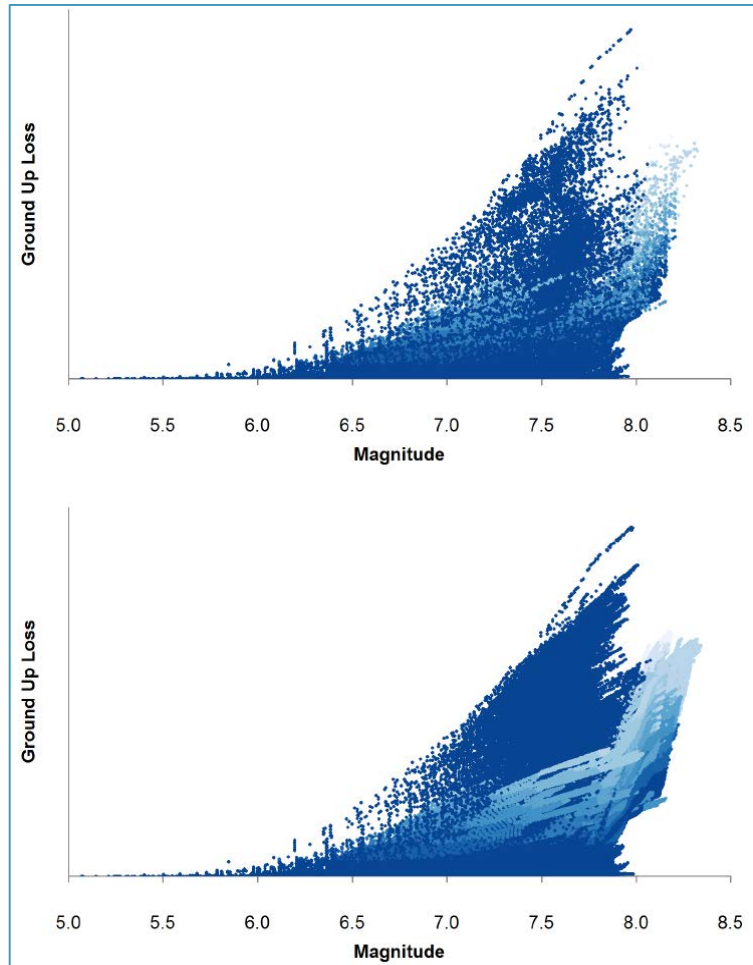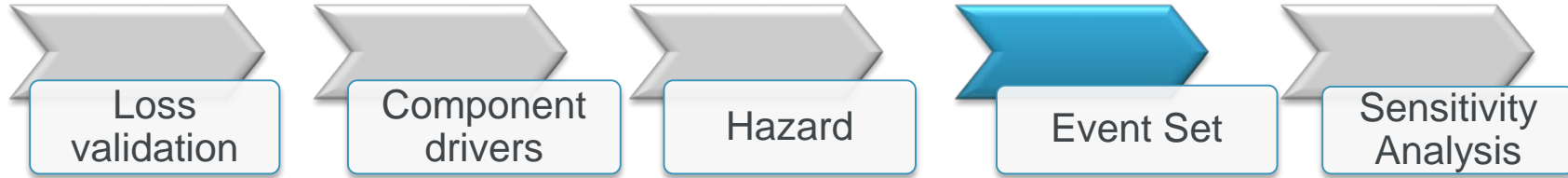
Loss validation | Component drivers | Hazard | **Event Set** | Sensitivity Analysis

Optimization

>360,000 events reduced to 53,000

Preservation of:
- AAL
- RP losses
- Total rate
- Mw distribution
- Spatial correlations

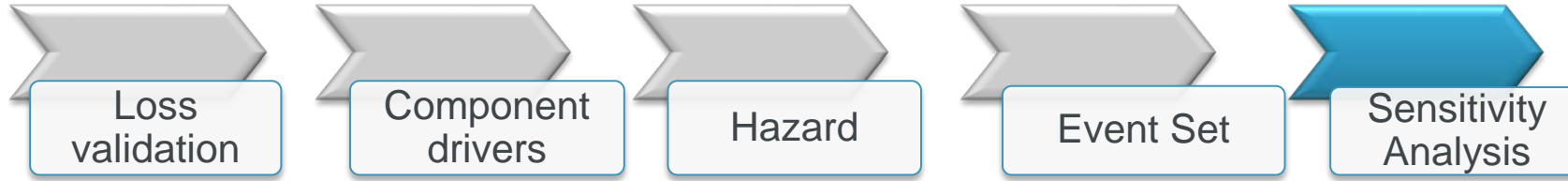Loss validation | Component drivers | Hazard | Event Set | **Sensitivity Analysis**

ABSOLUTE CHANGE IN GR AAL
- Alternate Vulnerability - Low
- Alternate Vulnerability - High

California | Pacific Northwest | New Madrid | Canada | Mexico
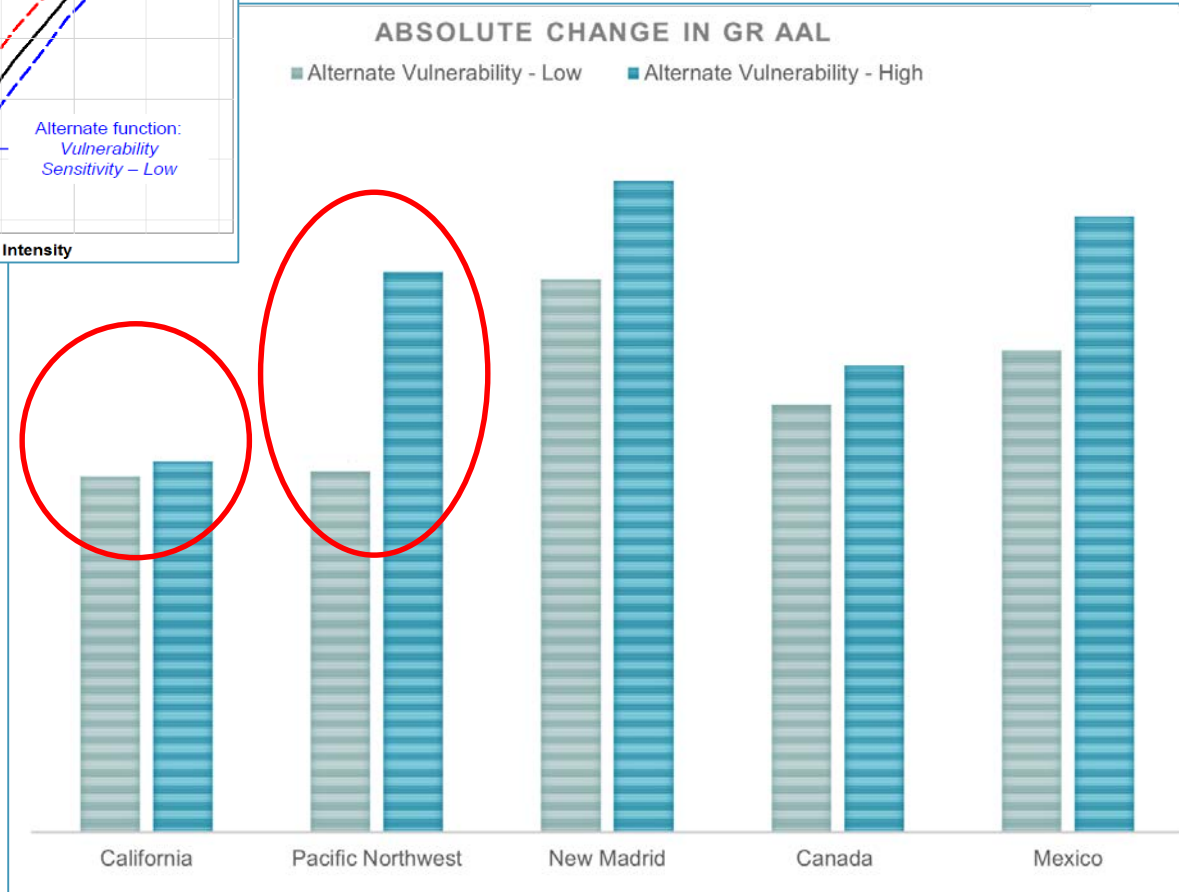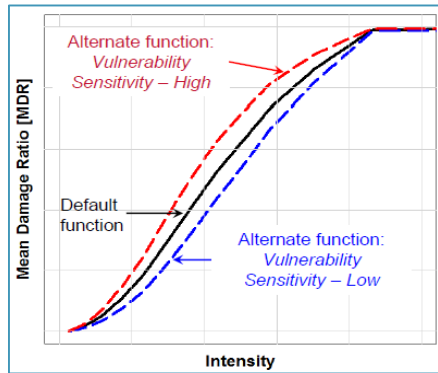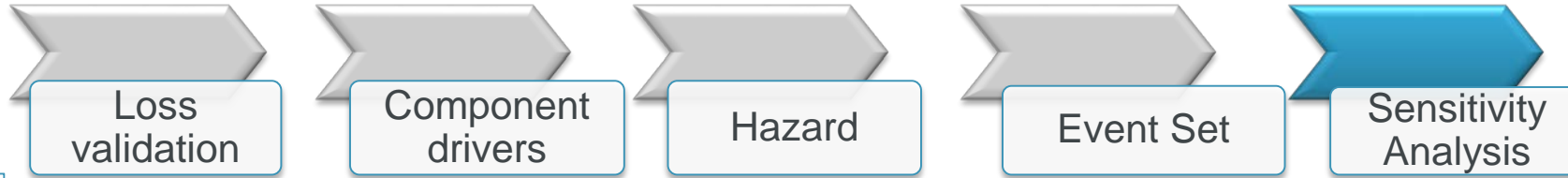
- Illustrates uncertainty of building vulnerability given hazard intensity within plausible upper / lower bounds relative to a mean damage ratio

- Due to differences in EQ-resistant building design / construction and response to ground-shaking

- Also due to availability of data to calibrate vulnerability curves

- High (Low) alternatives correspond roughly to 80th (20th) percentile damage ratios

- Useful relative measure of where models are likely to be more / less wrong

Mean Damage Ratio [MDR]

Alternate function:
Vulnerability Sensitivity – High

Default function

Alternate function:
Vulnerability Sensitivity – Low

Intensity

Expert Interviews

The USGS 2014 NSHMP is termed a consensus-based model – where are the main areas of disagreement among scientists?

How have you ensured your optimised event set is still representative of plausible but unobserved events?

What lessons learnt from recent events e.g. Tohoku & NZ were incorporated in the update?

What are the most important / fundamental expert judgements that we should be aware of that are changing?

For large events such as NM1811-12 and SFEQ 1906, what is driving the change in modelled losses?

What sensitivity tests are available to assess the materiality of expert judgements?

Supporting material

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Validation Principles
Overview

Capabilities

Validation Framework

Training

Effectiveness

Focus on Consistency

Business Led Validation

Process

Phased validation

Leverage vendor /broker validation
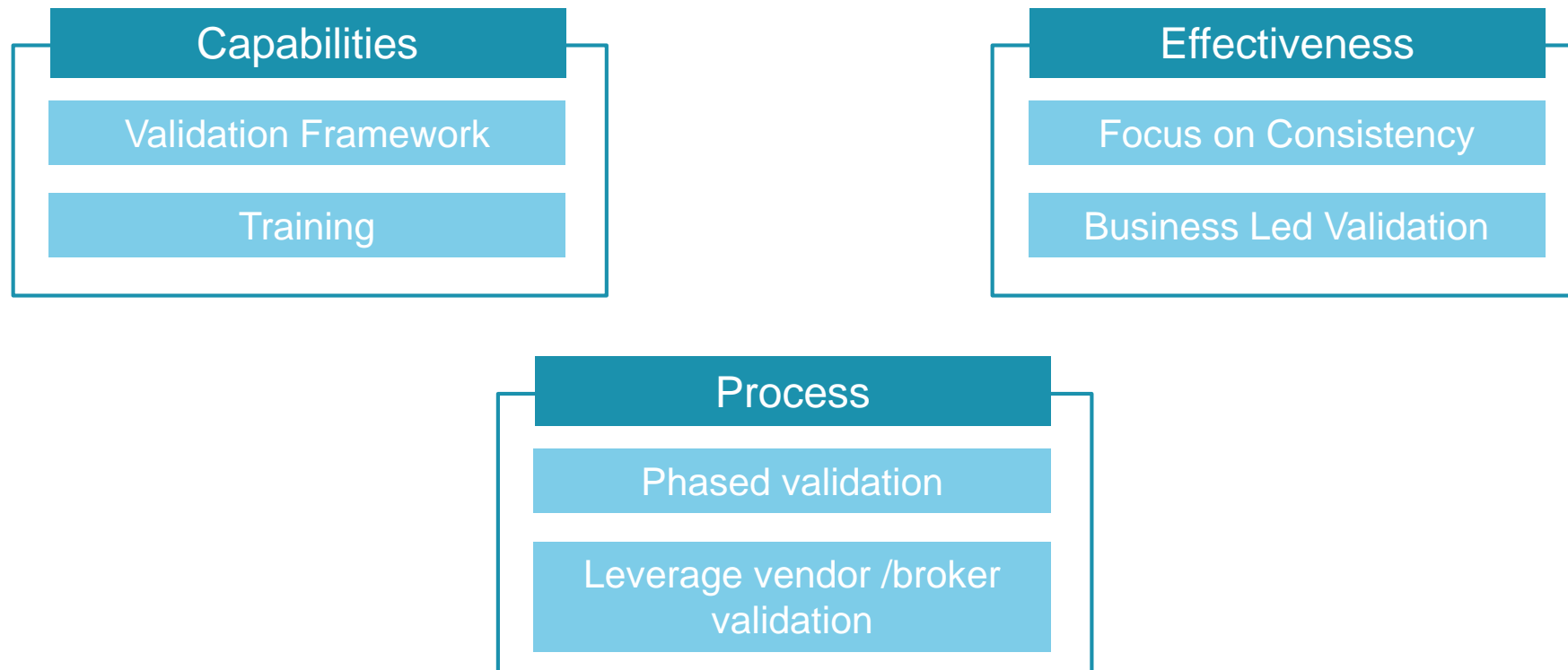
Validation Principles
Validation Framework

Topics	Structure	Tools
Data	Test specification	Analysis of Change
Model Design	Quantitative / Qualitative	Back-testing, lessons learnt
Loss Results	Results	Stress & Scenario Testing
Drivers	Pass / Fail criteria	Sensitivity Testing
Governance	Conclusions & Rec.	Benchmarking
		Functional testing
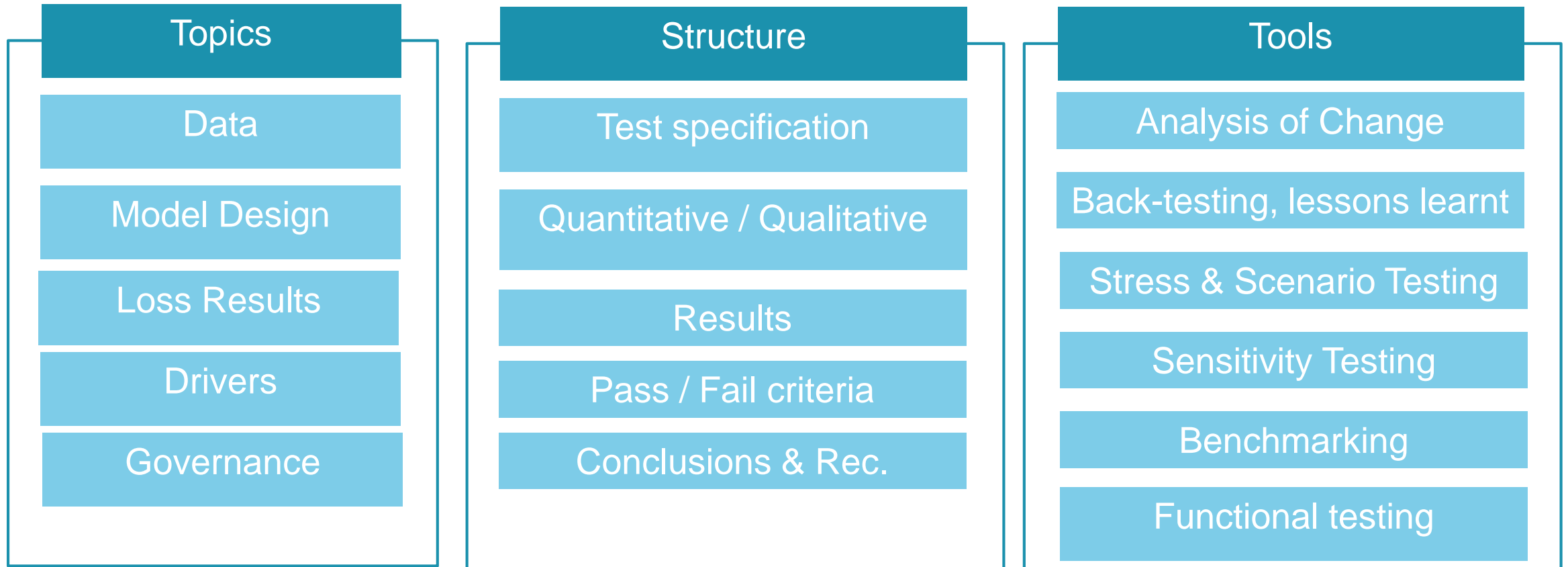
Validation Principles
Leverage external validation

North America Earthquake Models
Methodology Version 17.0

May 3, 2017

North America Earthquake Models
Historical Loss Validation Version 17.0

May 12, 2017

LMA Exposure Management Working Group

New Science in Earthquake Risk Modelling – Panel Discussion – 11th July 2017

Panelists:

- Vitor Silva – Global Earthquake Model
- Robert Muir-Wood – RMS
- Peter Stafford - Imperial College
- Claire Pontbriand - AIR
- Maiclaire Bolton - CoreLogic
- Siamak Daneshvaran - Impact Forecasting
- Tiziana Rossetto - UCL

Summary of key themes and issues raised

Many of the speakers focussed on similar themes related to the specifics of the new earthquake formulations. These included:

- Uncertainties associated with the subjective weightings applied to the logic tree formulations underlying the fault and ground motion components of the new USGS methodology.
- The incorporation of experience from recent international seismic events caused by multiple-segment ruptures have significantly influenced the distribution of event severity/recurrence within catalogues across the US. These have generated larger extreme tail events, across much larger geographic areas, including for the first time, 'whole California' fault ruptures which are influencing losses in the tail.

The panellists represent both vendor catastrophe modelling companies and academic experts. Questions will focus on how the new USGS formulations are being applied by the vendor companies in their new models, and how industry users should interpret the model change in light of both the USGS views, as well as vendor model approaches to their inclusion in the models, as well as other factors.

Validating Model Adjustments
Guidance for Validators

- Adjustments address data / model limitations and should be based on credible benchmarks

- Internal as-if claims history is a credible basis for adjusting models at low return periods

- At high return periods, model comparison and qualitative expert judgement is required to surface potential limitations
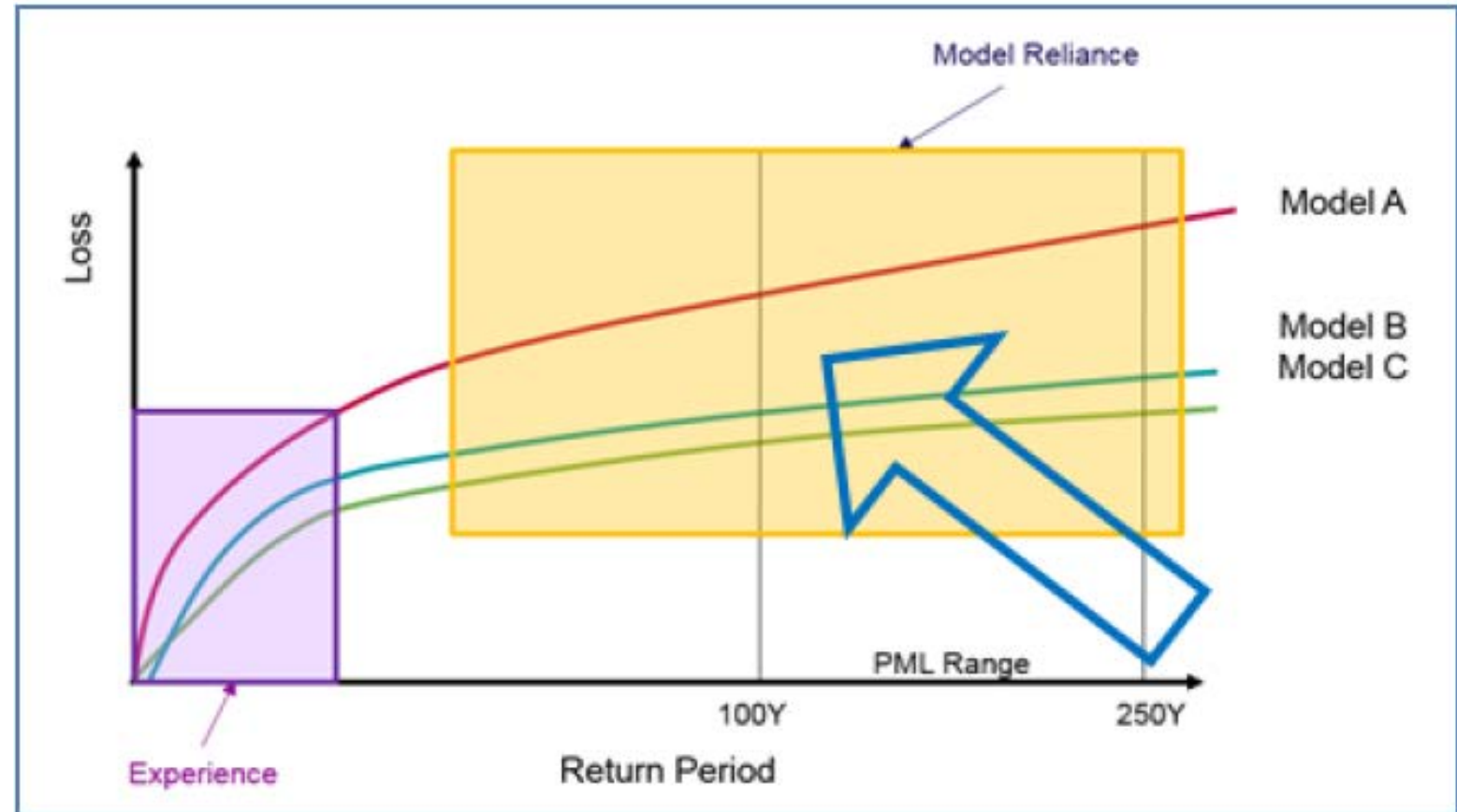
Validating Model Adjustments
Guidance for Validators

1. What limitations does this adjustment address?

2. How is the adjustment applied:
   a. EP load or explicit distribution from in-house model
   b. Linear or non-linear EP load

3. What benchmarks did the modeller consider in quantifying the adjustment factor / calibrating the in-house model and how were they applied?

4. Is the adjustment / model risk sensitive (to changes in hazard, building stock or policy conditions)?

5. Were generally accepted actuarial principles employed? (parsimony, goodness of fit, freq-sev models, etc)

6. Is the approach proportionate given the materiality of the limitation?

7. Is the approach easy to communicate?

8. Is the approach easy to govern?

Guidance for Governance Sign-Off

Motivation for changing current approach

- Provide Context:
  - How material is the region-peril to which the change request relates? [quote current stand-alone 1% TVaR, expected loss, 1:100 / 1:250 OEP / AEP VaR]
- State the current method / model used in production
- If relevant, list limitations of current approach, else justify why you are proposing the change: e.g., post-loss review, new model/science, general update, etc.
- Market context: what is the market adopting and when?

Proposed approach

- Describe the proposed method stating explicitly how the method addresses the weaknesses / limitations identified in the motivation for change
- Clearly state the scope of impact of the proposed method:
  - Treaty
  - D&F,
  - Business underwritten at Lloyd's,
  - Pricing,
  - Capacity Management,
  - Cat Risk SCR calibration

Impact Assessment

Scope: for affected business activities:
- **Timing:** if implemented, for which renewal will this change be effective / implemented?
- **Pricing:** what is the anticipated impact on SCOR's portfolio / impact on major cedants relative to prior year pricing?
- **Capacity:** what is the impact on the scope / modelling basis for monitored region-perils?
- **Cat Risk SCR:** How do you anticipate the method will affect the calibration method and / or adjustments applied in the Cat Risk calibration process?
- **Systems:** what changes are required? (for instance, default adjustments to be updated)

Next Steps

What are the next steps with regards:
- Handbook / Manuals / SII docs
- Cat Capacity Monitoring
- Cat Risk SCR calibration
- Systems
- Pricing
- Communication to underwriters
- Risk Management, Regulator Communication

Compliance

- Did you use the Validation test plan templates & abide by the principles set out in External Model use Guidelines?
- If applicable, state if there has been peer review by other technical specialists and outcome of this review
- Has the proposal been endorsed by the Regional Cat Manager?
- Did you insert links to shared folders / more detailed documentation on the proposed method / model?