



OLIVER WYMAN

“RAISING THE BAR” ON MODEL VALIDATION

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- **Do not** discuss what you or other entities plan to do in a particular geographic or product markets or with particular customers.
- **Do not** speak on behalf of the SOA or any of its committees unless specifically authorized to do so.
- **Do** leave a meeting where any anticompetitive pricing or market allocation discussion occurs.
- **Do** alert SOA staff and/or legal counsel to any concerning discussions
- **Do** consult with legal counsel before raising any matter or making a statement that may involve competitively sensitive information.

Adherence to these guidelines involves not only avoidance of antitrust violations, but avoidance of behavior which might be so construed. These guidelines only provide an overview of prohibited activities. SOA legal counsel reviews meeting agenda and materials as deemed appropriate and any discussion that departs from the formal agenda should be scrutinized carefully. Antitrust compliance is everyone's responsibility; however, please seek legal counsel if you have any questions or concerns.

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Agenda



What's changed?



Model validation techniques

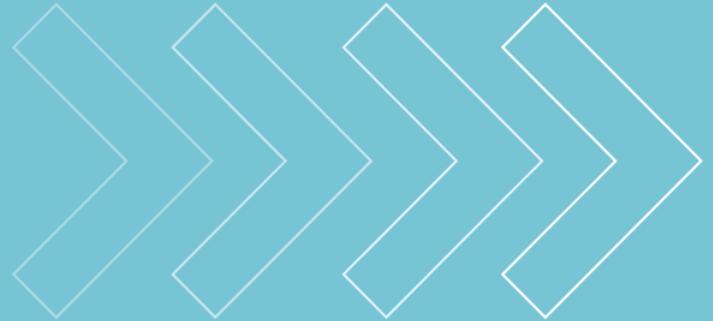


Case studies



Best practices

What's changed?



US GAAP LDTI - summary

Areas impacted by GAAP LDTI

DAC	Traditional liabilities	Market risk benefits	Disclosures
<ul style="list-style-type: none">• “Straight-line”• No longer tested for impairment• No shadow OCI• Similar changes to “DAC-like” balances	<ul style="list-style-type: none">• Unlocking• Best estimate assumptions• Market bond yield discount rates¹• Interest rate risk to OCI	<ul style="list-style-type: none">• All other-than-nominal market risks that provide protection to contract holder measured at fair value• Instrument specific credit risk to OCI	<ul style="list-style-type: none">• DAC and liability roll-forwards• Assumptions updates and judgements• LRT/NP cap details• And more...

¹Cash flows are discounted using upper-medium grade (low credit risk) fixed-income instrument yields.

US Stat PBR - summary

Areas impacted by PBR

VM-20: Life products

- VM-20 reserve = 3 components
 - NPR = mostly prescribed assumptions, minimum floor
 - DR = Assumptions based on company experience where credible, single deterministic scenario
 - SR = Same liability assumptions as DR, scenarios based on ESG
- Deterministic Exclusion Testing
- Stochastic Exclusion Testing

VM-21: Annuity products

- VM-21 maintains much of AG43
- Aggregate reserve = Max (Standard Scenario amount, CTE amount)
 - Standard Scenario reserve similar to VM-20 DR
 - CTE 70 reserve similar to VM-20 SR

Other requirements

- VM-31 = reporting and documentation
- VM-50 = Experience reporting requirements
- VM-G = Corporate governance (Board, senior management, qualified actuary requirements)

ASOP 56 – modeling standards



Development and use

- Separate production and sandbox environments
- Change controls
- Input and output management
- Documentation



Validation

- An ongoing & independent verification activity
- Ensures that model calculations are performing as expected and used consistently with intended purpose



Oversight

- Governance framework including roles, responsibilities, and standards
- Model inventory and risk assessment

ASOP 56

Professional standards and guidance when “designing, developing, selecting, modifying, using, reviewing, or evaluating models.”

Opportunities for model validation

Input



- Modernize data architecture and processes to extract, transform, and load
- Refine assumptions and align with other projection bases

Calculations



- Enhance model functionality, remove simplifications, and adopt new software features
- Review modeling standards and methodology decisions

Output



- Streamline reporting and minimize downstream processing
- Build strategic analytics to enhance business decisions

Model validation techniques

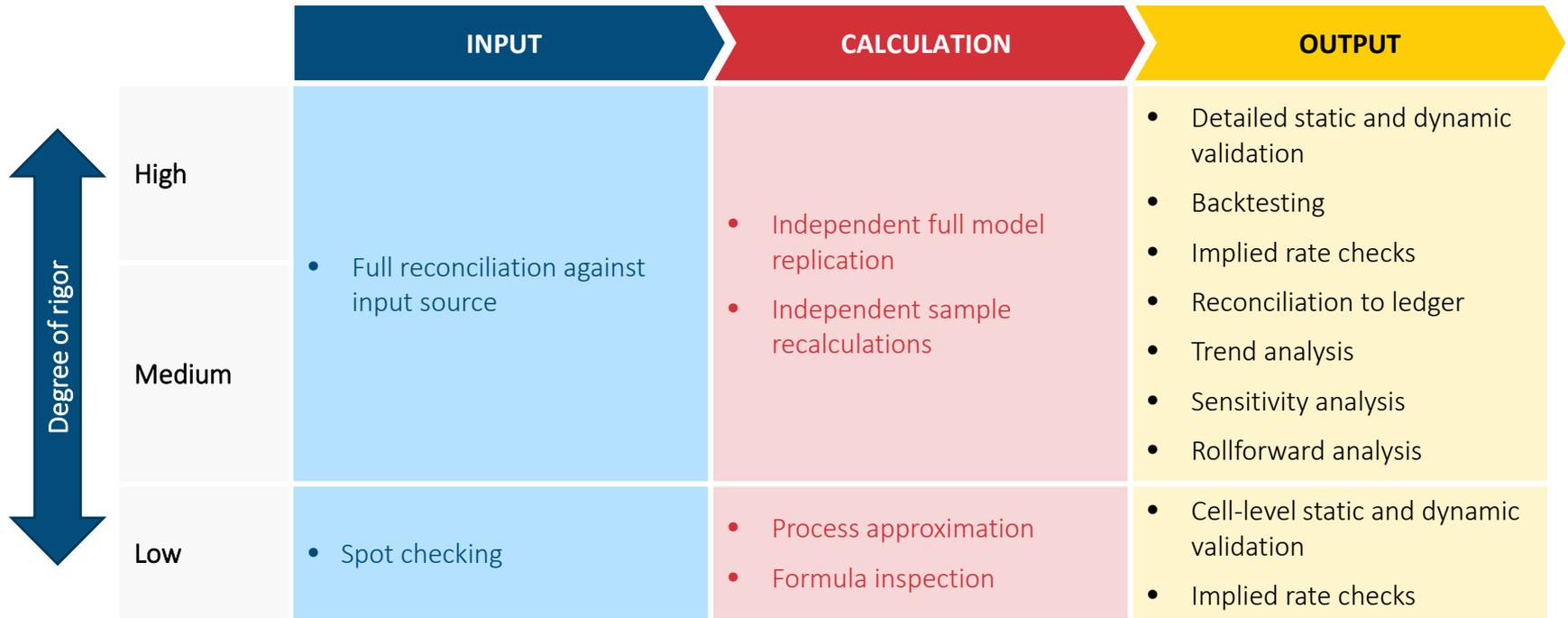


Risk-based approach to model validation



		Potential risk
1	Model identification	High
2	Model risk assessment	Low
3	Data collection	Medium
4	Testing and quantifications	High
5	Documentation and communication	Low
6	Remediation	High
7	Sign-off	Low

Model validation techniques



The degree of rigor in a model validation should align with the risk of the model component

Case studies



Model validation techniques

		INPUT	CALCULATION	OUTPUT
 Degree of rigor	High	<ul style="list-style-type: none"> Full reconciliation against input source 	<ul style="list-style-type: none"> Independent full model replication Independent sample recalculations 	<ul style="list-style-type: none"> Detailed static and dynamic validation Backtesting Implied rate checks
	Medium			<ul style="list-style-type: none"> Reconciliation to ledger Trend analysis Sensitivity analysis Rollforward analysis
	Low	<ul style="list-style-type: none"> Spot checking 	<ul style="list-style-type: none"> Process approximation Formula inspection 	<ul style="list-style-type: none"> Cell-level static and dynamic validation Implied rate checks

Case study #1 – input validation

You are validating the data input process for the new LDTI model in the testing environment. You confirmed the accuracy of the inputs and notified IT to move the data to the Production environment. Controls are in place to reconcile data movement between testing and Production.

What key risks are presented and what are their possible solutions?



Case study #1 – input validation

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Risk

- Input data may be lost after model run
- Improper mapping of inputs
- Manual data process and controls may introduce error

Solution

- Establish streamlined and automated control process to verify inputs and outputs
- Spot checking of material inputs and assumptions
- Time zero static validation
- Periodically review controls

Model validation techniques

	INPUT	CALCULATION	OUTPUT
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Case study #2 – model simplifications

Your company converted to a new modeling software as part of LDTI implementation. Certain immaterial product features are modeled using a simplified approach. Your actuarial student has compiled informal documentation of the simplifications and quantified financial impacts in a spreadsheet.

What key risks are presented and what are their possible solutions?



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Risk

- Simplifications could have unintended consequences to other parts of the models
- Inconsistency in reported reserves
- Simplification may be too aggressive, impact may increase over time
- Key person risk

Solution

- Framework for monitoring and assessing simplifications
- Formal documentation of key methodologies
- Sensitivity testing / quantifying financial impacts regularly
- Policy level testing and reconciliation to model output

Case study #3 – model software update

The software vendor just performed a formula database upgrade to fix a bug affecting the calculation of VM-20 seriatim level profits in the post-level term period. You reviewed the correction in the new version, performed a unit testing on one policy and confirmed the new software version is good for use.

What key risks are presented and what are their possible solutions?



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Risk

- Version upgrades may also involve other bug fixes and enhancements
- Model methodology and calculation may be compromised for other blocks of policies
- New bugs may be introduced as part of the upgrade

Solution

- Establish policy-level validation tools that test a more robust sample
- Periodically determine model versions to be used
- Perform regression testing
- Review vendor's bug and enhancement reports during upgrades

Model validation techniques

	INPUT	CALCULATION	OUTPUT
High	<ul style="list-style-type: none"> Full reconciliation against input source Assumption benchmarking 	<ul style="list-style-type: none"> Independent full model replication Independent sample recalculations 	<ul style="list-style-type: none"> Detailed static and dynamic validation Backtesting Implied rate checks Reconciliation to ledger Trend analysis Sensitivity analysis Rollforward analysis
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Case study #4 – validation scope

Your model development team completed the new traditional life GAAP model. They also performed unit testing, stress testing, and single policy testing. They conclude the results are reasonable and move the model to production. The Valuation team relies on the development team's testing.

What key risks are presented and what are their possible solutions?



Case study #4 – validation scope

Your model development team completed the new traditional life GAAP model. They also performed unit testing, stress testing, and single policy testing. They conclude the results are reasonable and move the model to production. The Valuation team relies on the development team's testing.

Risk

- Rigor of model validation techniques are insufficient for the associated model
- Key modeling errors may not be detected due to lack of separation of duty
- Modeled results may lead to inaccurate financials

Solution

- Secure buy-in of testing plan from key stakeholders
- Clearly define roles and responsibilities of model governance process, and review periodically

Best practices



A robust model development cycle can result in infrastructure that is easier to maintain

○ INITIATION

Model Owners

- Scope and assumption development
- Review, analysis, and decision support

○ IMPLEMENTATION

Production / operation

- Run scheduling and execution
- Infrastructure maintenance
- Controls

○ APPROVAL

Oversight committee

- Sign off for model changes and fit for use

○ EXECUTION

Model development

- Planning & design
- Functional specification
- Control implementation
- Unit testing

○ VALIDATION

Testing

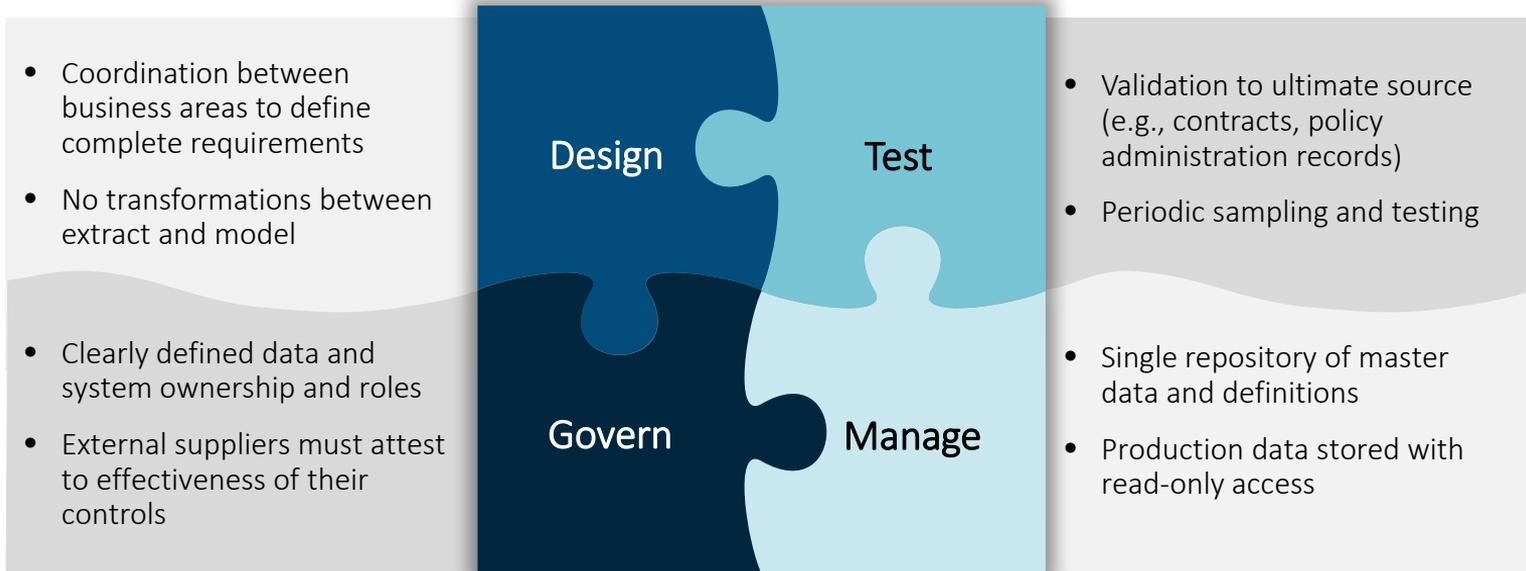
- Test plan and test case development
- Model validation

○ REVIEW

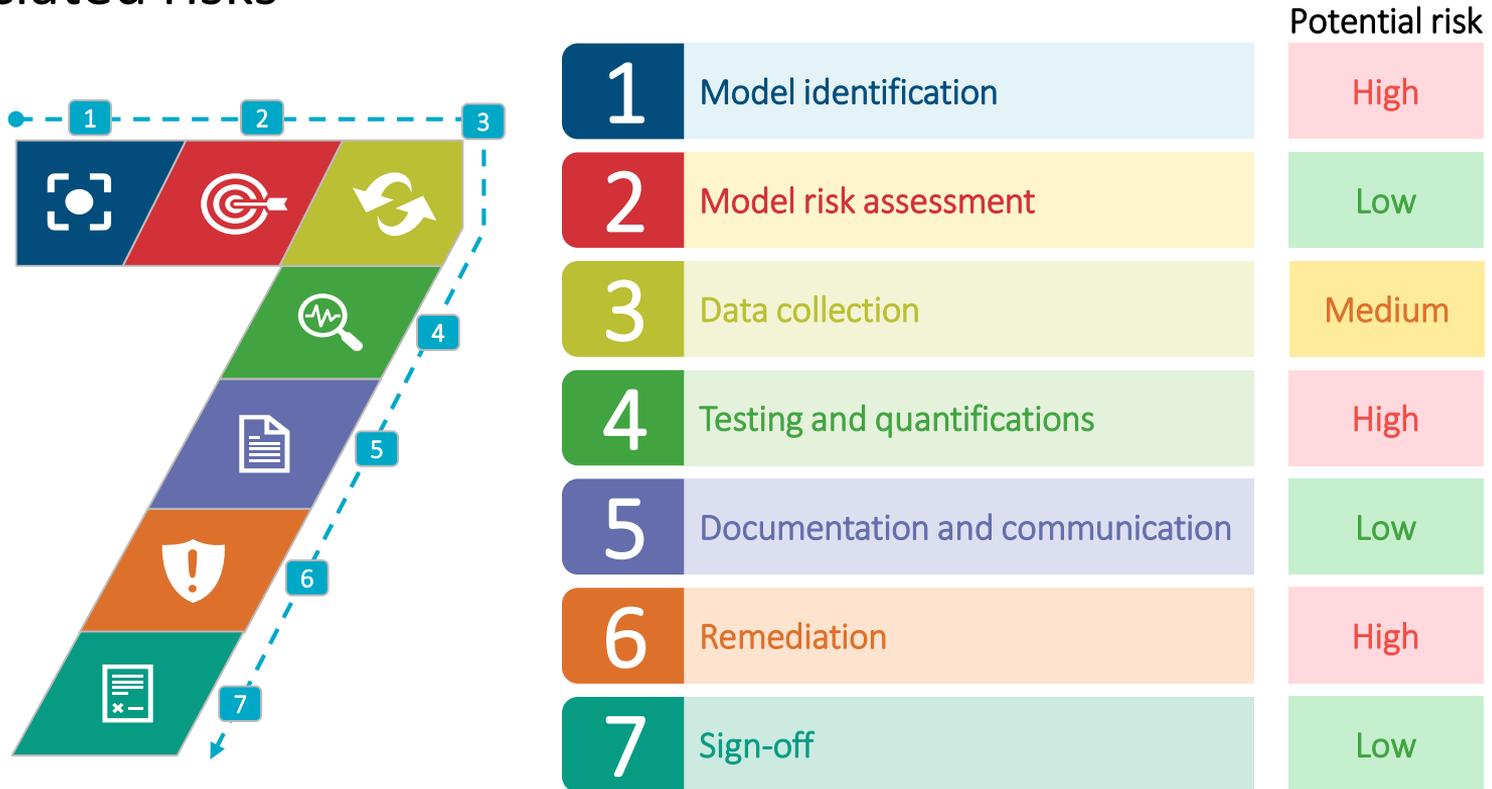
Model owners

- User acceptance testing

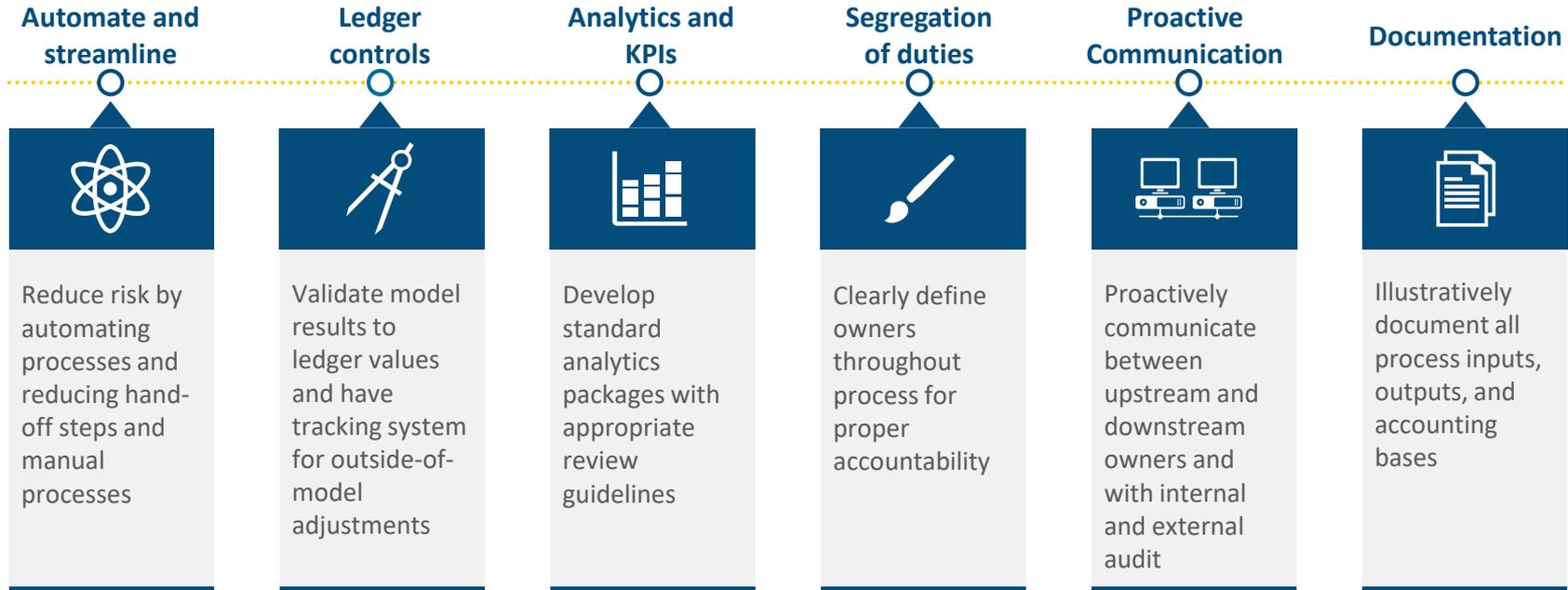
A well-designed data input process will require less upkeep



The rigor of validation techniques will be fully aligned to their associated risks



Reporting and communication of results will be streamlined with analytics tools and controls





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