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Adding Value With Model Validation: AG43 Model Validation Case Study

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In Issue 6 of *The Modeling Platform* (November 2017), we wrote a conceptual article about model validation. We defined what we believe a model validation should entail, the value proposition for stakeholders, the ways in which we gain stakeholder buy-in, and how we work with stakeholders to achieve consensus on issues, findings and mitigations. We asserted that the model validation effort could be used to affect organizational culture change from a routine task-oriented, "production" mindset to a "value-add" perspective that is focused on analysis, risk management and continuous improvement. We also touched on how the control functions in our organization (second and third lines of defense) collaborate and rely on our respective strengths to perform model validations, identify issues and manage mitigation efforts.

This article delves deeper into the tools that should be in place to support a validation program and then covers a case study in the application of our concepts on a validation of an Actuarial Guideline 43 (AG43) model. It should be noted that although we draw on our experiences validating and auditing models to write this article, this article is theoretical in nature and is not about a validation of one of our employer's AG43 models.

MODEL VALIDATION PROGRAM REQUIREMENTS

A sustainable model validation program that facilitates successful validation engagements requires meticulous planning and a clear set of shared expectations from each of the three lines of defense (LODs). To that end, there are certain artifacts, preparation milestones and processes that need to be put in place and maintained by each LOD prior to and throughout each validation engagement. In this section we outline these elements of the program and discuss how their implementation helps achieve the desired goals of model validation in the context of close collaboration among the LODs. Each element is designed to add value to the process and establish a feedback loop for the stakeholders during the actual validation initiatives and post-validation activities through a well-defined, documented and consistent approach.

Model Governance Policy

The model governance policy (the Policy) provides a clear definition of what types of applications, such as spreadsheets and systems, constitute "a model," as differentiated from a "business process" or a "calculation tool," and lays out a framework and guidance on how to treat model structures and operational "model units" residing on various software applications and platforms.

In addition to defining models and outlining the domain and scope of model governance, the Policy also specifies the organization's methodology for model risk assessment and risk-based control standards. This methodology must be designed to cover all models and be consistently applied across all business units, processes and individual model applications. The risk assessment approach has to be well understood by all model owners, as they are the ones to carry it out and, ultimately, to ensure that appropriate and sufficient risk-based control mechanisms are implemented around their models. Instilling risk control mindfulness within the organization, top to bottom, is one of the main objectives of a successful model governance program. Together with subsequent model validation efforts, they are the main agents of affecting cultural change from viewing model risk management as a hindrance to modeling to that of a major benefit in protecting the company.

An integral component of the Policy is documentation guidance. Any deep-dive validation efforts would involve collection of related artifacts from the model life cycle (such as business, functional and technical specifications, test cases, data dictionaries, etc.) and comparing existing model documentation against some sort of a standard (e.g., a documentation template or a set of requirements or guidelines). To a great extent, the success of a model validation depends on the availability of documentation (completeness, appropriateness, accuracy and accessibility), which shortens the discovery phase of the validation and allows the validator to spend more time on analysis and evaluation of the actual model.

Properly created, maintained and updated documentation benefits all model stakeholders as it mitigates key person risk for the first line of defense (i.e., allows non-owners to run the model and shortens training time). In addition, it reduces the burden on the validator who is a member of the second line of defense. Finally, it provides a standard on what the mitigation efforts need to accomplish, enabling Corporate Audit (third line of defense) to plan and monitor mitigation progress.

Enterprise Model Inventory and Risk Assessment

A model validation program is built around the availability of an accurate and up-to-date Enterprise Model Inventory, covering all models and their supporting applications for the entire organization. This inventory is maintained at the local business

area level but is consolidated at the corporate level. Decisions on how to plan and schedule model validation engagements are primarily based on two inventory requirements:

- Accurate and consistent model risk rankings to enable appropriate selection of models for validation based on their criticality and the company's potential risk exposure (e.g., materiality, reliance for decision-making, complexity)

- Appropriately captured and classified model characteristics (across business areas, products, supported processes, platforms, downstream usage of model results)

Simply being able to have a lens into the complete inventory and the opportunity to analyze it across these dimensions can go a long way in designing an optimal validation agenda that minimizes the burden on local business areas. For instance, the planners may decide to include multiple models in a single validation if, for example, they reside on the same platform (e.g., GGY Axis or Prophet) or support the same business process (e.g., life or annuity reserve valuation) while the model stakeholders will not be excessively burdened by multiple requests for documentation and walk-throughs. Another example is selecting upstream and downstream models for a single validation effort in a case where the upstream model's output is used as the downstream model's input (e.g., interest rate assumptions).

Model Validation Preparation, Planning and Requirements Checklist

The success of any deep-dive validation is rooted in the quality of the validator's preparation and planning for the engagement. Time and efforts spent up front on defining the actual objectives, scope and deliverables of any validation project and communicating this information to all relevant stakeholders will go a long way in defining shared hopes and building validator's credibility. Therefore, coming into each new initiative, the validator is strongly encouraged to put together a validation proposal, including planned timeline and resource requirements. The plan should cover the following elements: objectives and benefits, scope, roles and responsibilities, expectations of each stakeholder and defining the communication channels among all stakeholders.

To further ensure smooth execution, a standard checklist of requirements covering the milestones and deliverables of a deep-dive validation should be created and shared to guide all efforts regardless of the type of model or business area that is being validated. We view each validation as consisting of the following consecutive phases.

Discovery Phase

During this phase the validator collects and systematizes all information required for validation, including:

- Discussions with model owner(s)

- Collection of all model-related documentation (artifacts)

- Discussions with upstream suppliers of model inputs, including assumptions

- Discussions with downstream model users of model results

Analysis and Validation Phase

In the beginning of this phase the validator defines and describes the model components that will need to be analyzed and/or replicated for testing. These include key inputs, such as historic data and assumptions, and main elements of the calculation engine that will transform these inputs into outputs. We find it helpful to develop a model data and processing map/schematic that traces all inbound and outbound data flows and identifies those processes that the validator should independently replicate. Based on these definitions, descriptions and mapping, the validator develops a model blueprint (a simplified replica of the production model) or performs a detailed independent code walk-through (in cases where development of a blueprint model may be excessively time-consuming, such as for complex platforms or systems). In some cases, such as to perform scenario testing, a combination of creating a blueprint for some model components (e.g., programming sub-routines) and doing a code walk-through for others may be appropriate.

In order to properly evaluate the model's functionality, relevance of its assumptions and input data, the validator needs to define, design and document appropriate test cases, including use scenarios and limitations. Based on these test cases, the validator then identifies the differences between the blueprint and the production model and performs stress and sensitivity analysis under various assumptions for significant differences. Results of these tests should be promptly shared and discussed with the model owner.

Findings and Reporting Phase

The validator provides interim progress reports focused primarily on findings to date, prioritized according to their risk probability and severity. The reporting phase concludes with the creation of the Final Report, a validation close-out discussion and coordination with Corporate Audit on the mitigation plan. The Final Report includes the following sections: executive summary, gaps and proposed mitigations, error prevention and handling, and other recommendations or action items. The validation close-out discussion should address sign-offs on the Final Report and risk acceptance on findings that will not be addressed in the immediate future. The validator populates the Governance, Risk and Compliance (GRC) system with mitigations from the mitigation plan and then turns over mitigation management to Corporate Audit. Corporate Audit typically has expertise in mitigation management and can manage mitigations more efficiently than a validation team.

As we have gone through several validation planning phases, we discovered a few practices that can help with clarifying objectives, facilitating the validation and realizing shared hopes with stakeholders. Here are some helpful hints:

- Request the model owner(s) conduct a pre-validation self-assessment, whereby the model owner completes the model scorecard and the scores for each category are later compared to the actual scorecard completed by the validator at the end of the engagement.
- Hold one or more validation kickoff discussions attended by all stakeholders to "set the playing field" and ensure common understanding of the objectives and scope of the project.
- Provide a list of model life cycle artifacts to model owner(s) in advance of the validation so that they can get a head start in collecting documentation expected to reside in the "model space" (e.g., model development project plan, list of model benchmarks, peer review reports, sign-offs documentation).
- To ensure complete transparency of the process, the validator should establish a process and venue for ongoing communication with the model stakeholders throughout the engagement. Periodic sharing of an interim progress report, covering such items as upcoming deliverables, outstanding questions, new findings and potential findings being investigated helps keep all parties engaged in the process, informed of the status of validation and reduces the risk of surprises when reporting the findings or having to escalate potential issues.
- Ask stakeholders to fill out a short survey on their interactions with the validator and effectiveness of the validation itself, as this informs future engagements and serves as a confirmation of value placed on their opinions.

Model Validation Scorecard

Transparency, objectivity and consistency of evaluating a model are the principles ensuring that different independent validators with similar experience and expertise come up with roughly the same, or similar, scores for all model categories. These principles help build trust and credibility with the stakeholders, achieve a collaborative (non-adversarial) environment and improve the likelihood of achieving consensus on findings. The model validation scorecard should cover the following dimensions:

- **Fit for purpose.** The model is conceptually and methodologically sound for each model use.
- **Accuracy of calculations.** The modeling methodology is implemented correctly with accurate inputs and appropriate outputs.
- **Design and data processing.** The modeling environment, tools and design are appropriate for model uses.
- **Model governance and documentation.** Model control standards are implemented and the modeling process and technical functionality are accurately and comprehensively documented.

> Transparency, objectivity and consistency ... help build trust and credibility with the stakeholders.

Scoring Standards and Guidelines

The validation professionals are encouraged to define a set of general model scoring standards to be consistently applied across all validations, and share them with model stakeholders in advance of each engagement. These are best illustrated with an example from the "Fit for Purpose" category. The model is scored by the validator based on the following standard:

> The model achieves its overall objectives in support of specific business purpose(s)—e.g., process, domain, product, outcome—and satisfies requirements set for it in business, functional and technical specs. This metric should also consider the model's intended scope and robustness vs. functional limitations.

In addition to definitions of standards, scoring guidelines should be put in place outlining the scale of how models are evaluated for each category. There are two alternative scales that can be considered in designing scoring guidelines (let's assume a 1–5 rating, with 5 as the best score):

- Assume a score of 3 to be "average," whereby improvements can move the model to an "industry-leading" category.
- Assume a score of 5 to mean "fully compliant with the validation requirements," and any lower scores to indicate progressively larger deviations from requirements.

Validation findings can constitute a wide range of opinions, but typically can be classified into three main categories. Validators can use a standard H/M/L risk probability and severity scale or, instead, focus on benefits from implementing a solution or a recommendation to apply to these categories. We believe that findings fall into the following three broad categories:

- **Deficiency.** An adverse finding (e.g., methodology or calculation error) that presents an immediate or continued risk to the company if not corrected for a period of time.
- **Model risk.** An observation noted by the validator of a potentially risk-bearing finding that does not constitute an error, but which does create a risk for the company if not addressed.
- **Improvement recommendation.** An opportunity for improvement identified as carrying little or no risk to the company if not completed.

AG43 VALIDATION PROCESS

To illustrate the concepts and approach to a deep-dive model validation mentioned in the previous sections, we will walk you through a hypothetical AG43 validation example and phases, focusing on the various scorecard categories. For each of the phases, the validator would go through a set of steps to evaluate the model's compliance with these categories.

Fit-for-Purpose

The model produces reasonable AG43 reserves, and is expected to continue to do so in the future as well as be able to apply modifications and updates to react to potential future regulatory changes with reasonable ease.

Discovery Phase

- Discuss with the model owner any product features, such as company-specific variable annuity guaranteed living benefits (VAGLBs) and how they are implemented in the model. What type of hedging strategy is used? What are the expectations for it?
- Collect model artifacts related to the VAGLBs (e.g., technical documentation, sensitivity and model change testing, results monitoring).

Analysis and Validation Phase

- Ensure that model concepts and their implementation comply with existing regulations, laws, company policies and industry practices.
- Verify reasonability and internal consistency of assumptions (e.g., dynamic lapses and annuitization, base benefit growth, expenses and fund charges).
- Review the process of setting assumptions (e.g., how often they are reviewed, what sources are used, who is responsible for the process) and evaluate their consistency with standard industry practices.
- Validate that model results are distributed to downstream users and decision-makers with appropriate and complete supporting data to be used in the relevant context (e.g., reserves, trend analysis, sensitivities).

Findings and Reporting Phase

- **Deficiencies.** The model contains a material error or is noncompliant with the existing regulation by a government body, professional governing association, company policy or standard industry practice (hopefully this is not the case); a noncompliance finding should immediately trigger remediation efforts.
- **Model risks.** Mostly assumptions related (e.g., assumptions are not being reviewed as often as the regulations or industry standards require, they are not consistent, or the process of changing them is not well documented).
- **Model improvements.** Examples may include a validator proposing implementation of new product features, standard scenario changes, tax reserve calculations changes and so on. Doing this proactively will also help actuaries on value-added activities, such as analysis rather than coding, data manipulation or administration.

Accuracy

There are no technical errors in the model. The inputs and outputs are controlled and calculations match expectations.

Discovery Phase

- Discuss with the model owner the process of calculating the reserves. Are the Standard Scenario Amount (SSA) and the conditional tail expectation (CTE) amount calculated on the same software package or different ones? If the latter, how are the in-force extracts reconciled, where is hedging applied, and where is the final result calculated? Also are there any limitations to the calculations (e.g., running fewer than 1,000 scenarios for CTE because it is "too time-consuming"; missing data for some calculations, such as certain product features not included in the in-force file)?

- If any limitations are disclosed, ask for any top (down) side adjustment made to account for these limitations.

Analysis and Validation Phase

- **Technical issues.** Make sure there are no coding errors (e.g., base benefit resets or dynamic lapses can be very complicated; creating a spreadsheet to mimic them would help with the checking). Request audit files from the software, especially for SSA calculations, and replicate the calculations from first principles. Audits should cover a wide variety of cases including all LBs offered by the company.

- **Outside adjustments.** If there are any outside adjustments to the model results due to system limitations, make sure they are reasonable.

- **Accuracy of data inputs.** What controls are in place? How are assumption changes tested? Items to look for here include in-force extract reconciles to the sources; after an assumption(s) change the following three steps are completed: (1) assumptions match the sources, (2) the new assumptions are being read by the model properly and (3) regression testing is performed.

- **Accuracy of outputs.** How are they assessed? How is analysis done? Is there data to support conclusions from the analysis? Items to look for here are reconciling outputs to the inputs, reserve trends with thresholds triggering investigation, FV roll-forward, attribution analysis of the impact after assumption(s) change, sensitivity testing, and so on. If the CTE amount is greater than the SSA, what are the reasons for it (e.g., market conditions, too-rich guarantees)?

Findings and Reporting Phase

- **Deficiencies.** These are technical errors, missing controls, questionable testing of the assumptions.

- **Model risks.** Undocumented top (down) side adjustments to the results, poor rationale for variances and assumption inconsistencies, visual rather than automated testing of the inputs.

- **Model and risk improvements.** Examples may include an improvement of the hedging of LBs if the company does not use a clearly defined hedging strategy.

Design and Processing Phase

The modeling platform as well as the model allow for ease of future changes and maintenance.

Discovery Phase

Discuss with the model owner the platform or the programming language used for the model; companies usually use a vendor software package for the AG43 calculations and a home-office-designed hedge program. If the outputs are summarized separately, review the process as well. Discuss who is responsible for making model changes, testing them, sign-offs and running the model.

Analysis and Validation Phase

- **Version controls, space storage.** Every model change has it is own version; all old versions are archived; testing documentation, change management controls, and so on.

- **Ability to make future changes.** For the system: whether it is open or closed, vendor support; for the model itself: whether it was created to allow for changes. Is the model design easy to understand? Review past changes and efforts to make them; review the documentation of the model functionality.

- **Assess the efficiency of the model.** Is it easy to maintain? Is it optimized for runtime? Review runtime tests, automated assumption changes and testing.

Findings and Reporting Phase

- **Deficiencies.** Manual processes that can be automated (e.g., if the model has several different uses, set up a batch process to run all of them automatically); poor change management controls.

- **Model risks.** The model is not robust enough to make changes to it; there are system limitations that require adjustments to the results; only the last few versions of the model are being kept.

- **Model improvements.** Examples may include processes that can be done by other personnel rather than actuaries (e.g., in-force extracts can be created by IT who also can run the models allowing actuaries more time for analysis).

Model Governance and Documentation

ERM Model Validation and Corporate Audit collaborate on model governance. To ensure that there is consistency in model governance assessments and to facilitate leveraging each other's work product, Corporate Audit and ERM Model Validation developed a standard risk and control matrix (RCM). Corporate Audit has scale and expertise in assessing compliance with corporate policy. Therefore, it is preferable Corporate Audit perform model governance assessments rather than ERM Model Validation. This is a more efficient use of the enterprise's resources. As shown in Figure 1, the sample RCM has 10 controls that span the requirements documented in the Corporate Model Governance Policy (CMGP).

For this article, we will focus on the following controls: Enterprise Model Inventory, Change Controls and Model Documentation.

Enterprise Model Inventory

Every model has been risk-assessed and recorded in the Enterprise Model Inventory. The Policy identifies which controls are required for high-, medium- and low-risk models. Figure 2 shows this information included in the RCM to guide the auditor in determining which controls should be in scope of an audit.

During the planning phase of the audit, the auditor should identify the AG43 model owner's Model Governance Lead and verify that the Enterprise Model Inventory is current. The auditor

Figure 1
Sample RCM

Control Procedures			
Control Number	**Control Procedure Description**	**Control Number**	**Control Procedure Description**
1.1	**ERM Model Inventory**—There is a Model Governance Lead who catalogued the model within the Enterprise Risk Management (ERM) Model Inventory and risk-ranked the model in accordance with ERM's risk-ranking methodology.	**1.6**	**Data Backup & Version Control**—Model data and code is appropriately backed up, restorable and version controlled.
1.2	**Fit for Purpose**—When designing, building or developing a model, the user confirms the capability and constraints of the model (based on underlying methodology and assumptions) are consistent with the intended purpose. Ongoing oversight and testing of key aspects of the model are validated, reviewed and approved by an independent manager or modeling committee.	**1.7**	**Input & Output Validation**—Data that is input to the model, and the output generated, are reviewed for completeness and accuracy.
1.3	**Assumptions**—Assumptions are reviewed (or approved, depending on risk level) prior to model results being relied upon. Assumptions are evaluated periodically (frequency based on risk level) to verify they are still relevant and reasonable.	**1.8**	**Data Integrity**—A process exists to prevent or identify accidental or malicious overrides (of data, formulas, processing functionality, etc.) within models.
1.4	**Change Controls**—A formal process is used to establish, approve, analyze, test, communicate and record model changes (including assumption changes).	**1.9**	**Model Documentation**—Documentation is sufficient for other individuals to run the model, understand how it works, and understand the intended objective of the model.
1.5	**Restricted Access**—Access to models is appropriate for job responsibilities.	**1.10**	**Process Documentation**—Step-by-step instructions of the process (including folder locations, file names, file owners and controls) are sufficient to allow another user with an appropriate level of systems access to perform the process and reproduce prior results.

Figure 2
Enterprise Model Inventory

Control Procedures						Test Procedures
Control Number	Control Procedure Description	Inherent Risks	High	Med	Low	Test Step Detail
1.1	**ERM Model Inventory** There is a Model Governance Lead who catalogued the model within the Enterprise Risk Management (ERM) Model Inventory and risk-ranked the model in accordance with ERM's risk-ranking methodology.	**General risks**—Model misspecification of relationships, missing risk factors or ignoring material factors, leading to a business decision/recommendation not reflecting management intentions. **Loss of key employees**—leading to disruption in processes or inaccurate execution of processes that rely upon model results.	X	X	X	1. Confirm the model has a Model Governance Lead responsible for performing a model risk-assessment and updating the ERM Model Inventory. 2. Confirm the model has been inventoried, is risk-assessed, and there is an annual refresh of the assessment. 3. Perform an independent risk assessment using the ERM Model Risk Score Calculator. If Auditor assessment differs from business/ERM assessment, auditor to work with both parties to gain agreement.

accesses the inventory and extracts the model risk assessment. Assume that the self-reported risk assessment is 4.6 out of 5, which translates to a "High." This score should be a weighted sum of scores for several risk factors: materiality, complexity, key person risk, identified limitations or errors, user access and so on. The auditor performs an independent risk assessment of 4.75 out of 5, which also translates into a "High." The auditor works with the Model Governance Lead to come to a consensus on the risk factor scores where they differ. In this example, the differences are minor and changing the model owner's risk assessment would not change the overall risk score of the model. Therefore, the auditor documents in the test results that Model Governance Lead's risk assessment has been validated and the inventory is current. No issues or mitigations would be created. However, because the model is high-risk the auditor should include all 10 RCM controls within the scope of the audit.

Change Controls

During the planning phase of the audit, the auditor requests from the Model Governance Lead an inventory of all changes made to the model over the last four quarters. Figure 3 illustrates the associated considerations for Change Control. The model owner provides an inventory of six changes made during the development periods between valuation dates. The auditor uses sampling methodology and determines that 2 of 6 should be tested. The auditor decides that the sampling should be risk-based and selects the most complex change and the most impactful change.

The auditor's objective is to evaluate whether or not the model is subjected to a development life cycle. Figure 4 details the steps in a sample model development life cycle.

For each of the changes the auditor requests the following evidence from the model owner:

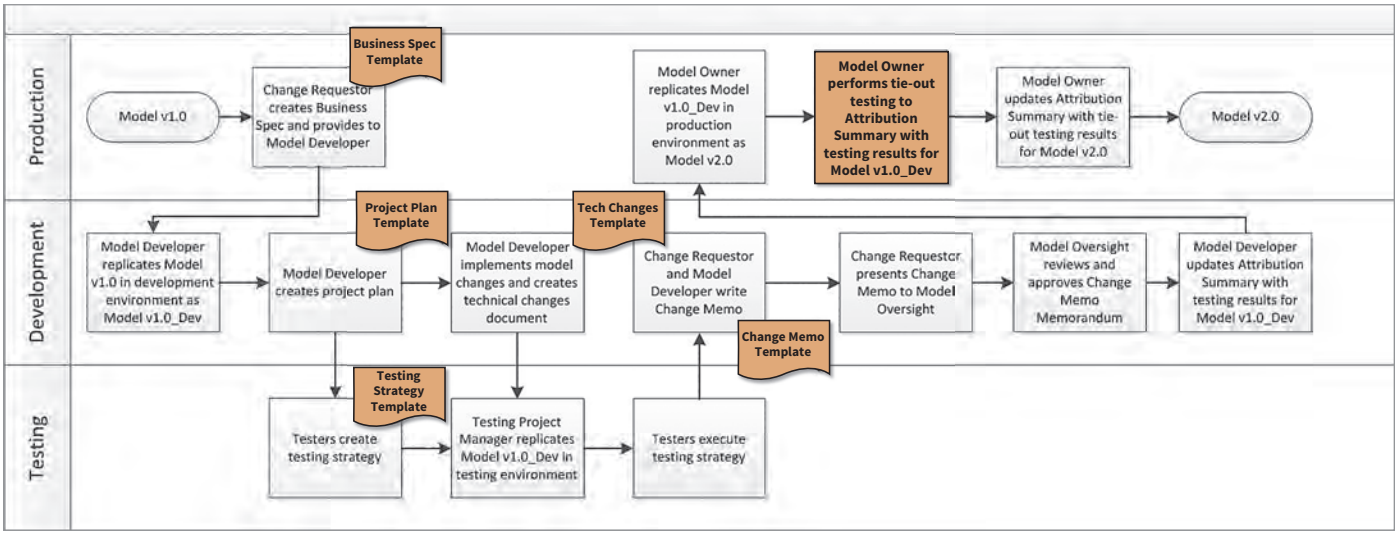
- **Business specification.** Provides the model developer with specifications for the change, example or prototype of the change and a quantification of the expected impact.
- **Project plan.** A project plan is usually only required for large, complex changes.
- **Testing strategy.** Documents the testers (must be different from the model developer), defines unit testing, User Acceptance Testing (UAT) and attribution testing requirements.
- **Technical changes.** Documentation of the changes made to the model and the purpose for each.
- **Change memo.** Provides a summary of the business reason for the change, support for how the model owner gained comfort with the impact.
- **Tie-out testing evidence.** Evidence that the production model produced the same results contained in the change memo.

For the complex change, the model owner may only provide a business specification and a change memo. For the most impactful change, the model owner may provide only a change memo. The auditor determines if the amount of analysis of the impacts is sufficient. The auditor also tests if the model was subject to a well-controlled development life cycle.

Figure 3
Change Controls

Control Procedures						Test Procedures
Control Number	Control Procedure Description	Inherent Risks	High	Med	Low	Test Step Detail
1.4	**Change Controls** A formal process is used to establish, approve, analyze, test, communicate and record model changes (including assumption changes).	**Inadequate change management of the model**—leading to unauthorized or unintended changes. **Model changes are not sufficiently tested**—leading to changes that do not meet business requirements and produce unexpected results.	X			1. Changes are documented, submitted and approved to oversight committee 2. Formal process for communicating errors into the model governance structure 3. Appropriate testing of the change 4. Formal process for communicating changes to model users, model output users 5. Impacts are calculated and recorded by version (it should be clear which changes were implemented in a production cycle and how each change impacted model results)

Figure 4
Model Development Life Cycle



For instance, what if development often took place in the production version of the model and at times during the production cycle? The auditor should then determine if changes were well-communicated and whether or not the lack of change controls exposed the enterprise to model risk. The auditor should discuss the identified issues with the model owner, as well as the business area's senior leader, and explain how implementation of change controls would mitigate model risks.

A best practice is to have Corporate Audit create a Model Governance Center of Excellence (MGCoE). Auditors skilled in assessing a model's compliance with CMGP can create the RCM, collaborate with second line of defense and assist model owners to comply with the CMGP. The MGCoE relies on existing resources in Corporate Audit and should not result in additional costs. The MGCoE should develop change control templates for business specification, project plan, testing strategy, technical

changes and change memo. In addition, the auditor can explain how the MGCoE could advise the business area on how to set up a model oversight committee and implement change controls. The auditor and the business should come to a consensus that change controls should be improved. The auditor should create the following mitigation in the enterprise's GRC system.

Hypothetical issue: Change controls are not sufficient and expose the enterprise to model risk.

Potential mitigations: The Valuation business area and the AG43 Model Governance Lead will:

- Implement a local model governance framework that will create a model oversight committee responsible for reviewing and approving changes to models
- Implement development life cycle for the AG43 model that will require all development is performed in a development version of the model and cease development prior to the beginning of a production cycle
- Create templates for business specification, project plan, testing strategy, technical changes and change memo for all changes
- Require a business specification, testing strategy and change memo for all changes
- Require evidence of tie-out testing when a development model is promoted into production

Model Documentation

During the planning phase of the audit, the auditor requests model documentation from the Model Governance Lead. Figure 5 further explains the Model Documentation control procedure. The Model Governance Lead may provide AG43 memorandum and assert that the memorandum was used to document the model. The auditor should then rely on the MGCoE's model documentation template and evaluate the AG43 memorandum to determine if it sufficiently documents the model. The auditor may conclude that although the AG43 memorandum does partially address model functionality, data, assumptions and parameters, it is not sufficient to be considered model documentation.

Model documentation should significantly mitigate model risk and key person risk. These risks are mitigated by documenting functionality, model and input limitations, the modeling flowchart, data dictionary and ongoing monitoring activities. By having such information documented, the business area creates opportunities for mobility of model ownership and knowledge transfer, ensures reusable training and smooth transition, and enables others to learn the model while freeing up key people to work on continuous improvement projects and add value to the enterprise.

Figure 5
Model Documentation

Control Procedures						Test Procedures
Control Number	Control Procedure Description	Inherent Risks	High	Med	Low	Test Step Detail
1.9	**Model Documentation** Documentation is sufficient for other individuals to run the model, understand how it works, and understand the intended objective of the model.	**General risks**—Model misspecification of relationships, missing risk factors, ignoring material factors, incorrect application or implementation, incorrect calibration, programming problems, etc., leading to a business decision/ recommendation not reflecting management intentions.	X	X	X	1. Compare content in model documentation to model documentation template. 2. Evaluate content in model documentation for accuracy and completeness.
		Loss of key employees—leading to disruption in processes or inaccurate execution of processes that rely upon model results.				

The auditor should again meet with the model owner and the business area's senior leader. The auditor presents testing results that demonstrate that the AG43 memorandum does not contain sufficient information to be considered model documentation. The auditor should explain how the memorandum compares to the MGCoE's model documentation template and that the template was designed by Corporate Audit and Model Validation to comply with model documentation standards in the CMGP and adheres to model documentation guidance from the current regulatory authority.

Finally, the auditor should explain how model documentation is essential to an enterprise's control functions in its efforts to assess and manage model risk. Documentation should be detailed enough such that auditors, stakeholders and other interested parties can understand how the model operates, its limitations and its key assumptions. The business area may concur but could express concerns regarding time and effort to produce ideal model documentation. The auditor agrees that the enterprise would benefit significantly from effective and complete model documentation but time and effort could be reduced by utilizing the MGCoE's template and populating the most valuable sections first. The auditor should walk them through the MGCoE's template and point out how each section contains guidance on content that should save the model owner time in determining what was appropriate or expected. After several follow-up discussions, the auditor and the business area should agree to create model documentation and target the most valuable sections.

The auditor creates the following mitigation in the enterprise's GRC system:

Hypothetical issue: Create model documentation for the AG43 model.

Potential mitigations: The Valuation business area and the AG43 model governance Lead will use the MGCoE template for model documentation and populate the following sections:

- **Model use.** Identify the business processes that utilize the model.
- **Model theory and calculation.** For each model use provide a high-level description of the model design and how it was implemented.
- Reliance on upstream models and impact on downstream models
- Model limitations
- **Alternate approaches.** Identify alternative constructs and reasoning to support the current construct used in the model rather than the alternative.
- **Model flowchart.** Inputs, model routines and outputs.
- **Model functionality.** Identify and document the critical functions that make this model fit-for-purpose. Documentation should be sufficient to allow the reader to utilize the model functionality.
- Data dictionary, limitations and weaknesses
- Assumption catalog, limitations and weaknesses
- Model development life cycle
- Ongoing monitoring activities

CONCLUSION

We hope that this article has demonstrated our holistic approach to model validation and how the first, second and third LODs work collaboratively. The second LOD (risk management) and the third LOD (audit) assume ownership of the components of a model validation where they have expertise and scale. In addition, they work in unison to assess compliance with the Policy. We designed our validation program to affect culture change in the direction of risk management and to add value to the business by providing an independent view into the credibility of the model. ■

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