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# Adding Value With Model Validation

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When we began building models in the 1990s, it would have been more than strange if an actuary or internal auditor showed up at one of our desks and said, "I would like to validate your model. Please provide me access to the model and all the associated documentation that you have for it."

Things have changed.

Model validation is widely viewed as an intrinsic part of a modeling paradigm. Regulators, external auditors and rating agencies all require it and publish guidelines and articles on what model validation means and how it should be performed. However, the only thing that outnumbers published articles on model validation is the various stages of maturity of model validation among companies in the financial services industry.

We are all aware of the advancements in computational power, the ever-increasing complexity of financial products, the evolution of valuation and capital requirements and the high-profile model breakdowns (e.g., lack of a national housing failure stress test) that all worked together to generate this sense of urgency for model validation. This sense of urgency has, of course, found its way into many boardrooms and the directives have been issued: validate all high-risk models in X years and all medium risk models in Y years.

At MassMutual, the development of the strategy and tactics to make this happen is entrusted to us. We are "old-school modelers" who have "seen the light." During our careers as modelers, we were introduced to the model development life cycle, and we were required to document our models and the processes that are supported by them. We have an appreciation for the benefit that a thorough model validation effort can bring to an enterprise, business area and model owner. We also have an appreciation for tact and realize that decrees, ultimatums and an authoritative "just do it" would destroy the type of modeling paradigm a model validation is intended to instill. We see in our work and experiences how model validation efforts have a transformative effect on the culture of an enterprise when it is multipronged, focuses on shared hopes and prioritizes stakeholder buy-in.

In this article, we define 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. Our objective is a model validation effort resulting in a transformed workforce and 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.

## DEFINITION OF MODEL VALIDATION

The very concept of model validation can have a different meaning to different people, and even modeling experts in various disciplines will have their own interpretations of what a true validation should encompass. Within the life insurance industry, there are multiple definitions of what constitutes a model validation and what objectives it sets to achieve. Some excellent papers on model validation have been published in the past few years:

- "Model Validation for Insurance Enterprise Risk and Capital Models" by M. Stricker, S. Wang and S. Strommen[1]
- "Anatomy of Model Validation Case Study" by M. Guglielmo[2]
- "Did Your Model Tell You All Models are Wrong?" by Systemic Risk of Modelling Working Party at University of Oxford[3]

We used these works to finalize our model validation process. In this paper, however, we want to complement them by discussing how to conduct successful model validations.

We share a holistic view of the goals of model validations as well as the approach to conducting validation efforts. That is, a validation is not just a deep dive into the accuracy of calculations, programming code logic or data inputs, but a comprehensive review of the entire model environment, including all model-related physical components, business processes intrinsic to its ecosystem, model and process documentation, change management process and documentation, model oversight, existing model governance framework and control standards. In addition, our scope of model validation includes the review of the process that was used to develop and implement the model, as well as the artifacts created during its life cycle (e.g., to ensure that it adhered to software development cycle and IT general controls).

The main objectives of a model validation include the testing of a model's conceptual soundness and continued fit for purpose, including identification of potential risks and limitations. These tests must constitute an effective challenge to the existing production model for the benefit of its improvement, risk mitigation

and future modeling and validation efforts, and provide comfort and confidence in the model's results to management or recommend changes/enhancements going forward.

Although we advocate a holistic approach to each validation, the efforts should be commensurate with the model's risk. For higher-risk models, especially those with potentially material impact on the organization's financial results or decision-making processes, a validation engagement is an independent deep-dive review and evaluation of the model's environment, design, functionality and compliance with regulatory and business requirements, enabling discovery of actual or potential errors or flaws, as well as identification and quantification of the model's true inherent and residual risks.

Consistent with the three-lines-of-defense (LOD) concept (see Figure 1), we also believe that, where appropriate and feasible, the most effective validation is one that synergizes the efforts and perspectives of the first, second and third LODs and leverages the relative strengths of each of these functions. This is achieved by combining the depth and detail of analysis and recommendations by a model validator who is an independent expert from the second LOD (e.g., an actuary or investment professional who is a member of the risk management organization) with the formalized, disciplined and structured approach to risk mitigation and post-validation follow-up (e.g., remediation based on findings and recommendations) carried out by Internal Audit (a third LOD). Model owners and their peers on the business side (a first LOD) maintain effective controls and implement necessary model and process changes to close out the recommendations and mitigations.

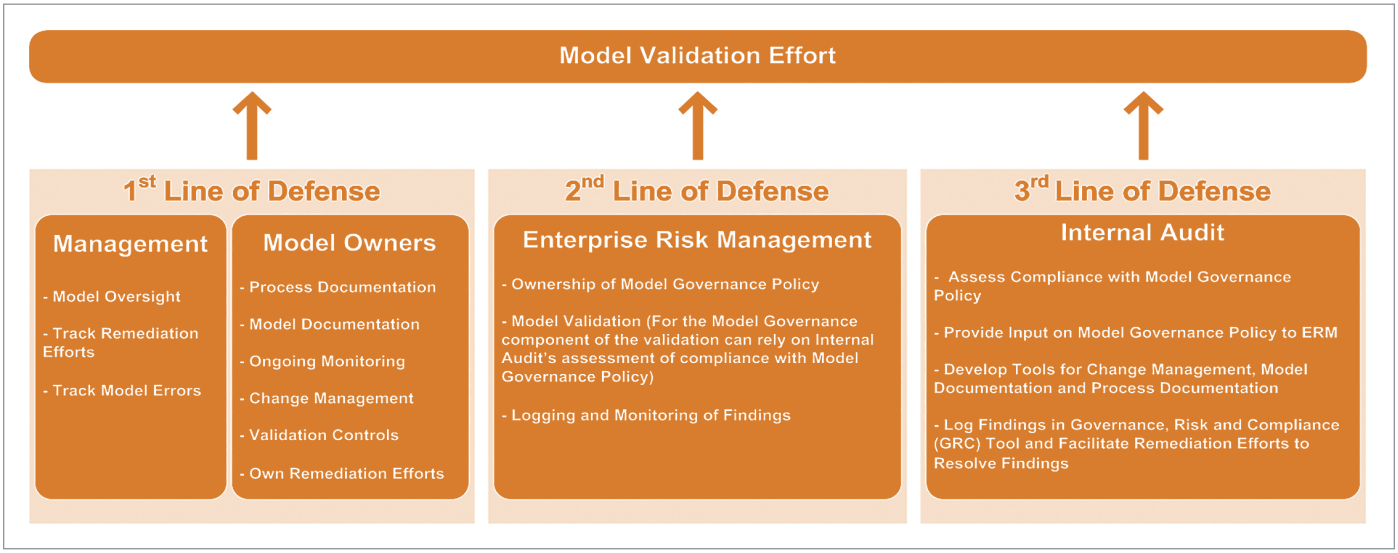
## MODEL VALIDATION'S VALUE PROPOSITION

We recognize that model validation is not likely to deliver long-term benefits unless the primary objective for each component is adding stakeholder value. When stakeholders realize value from model validation, they make it a priority. You create value when stakeholders realize benefits that exceed the additional labor and other costs to support the model validation effort. Effecting culture change, mitigating key-person risk and preparing for principle-based reserving (PBR) requirements are benefits that we believe exceed the associated costs and create value for stakeholders.

### Effect Culture Change

Our economy is rapidly shifting toward one where automation performs routine, task-oriented work and the workforce must focus on continuous improvement and analysis.[4] You may ask, "How does that affect actuaries?" Automation is already affecting the actuarial profession. Our actuarial workforce has historically focused on production activities like calculating reserves and other financial metrics on a recurring schedule. Actuaries develop models, place them into production and then spend most of their time on routine production tasks like creating in-force files, populating assumptions and aggregating model outputs. A small portion of an actuary's remaining time is available for continuous improvement and analytics. As automation capabilities improve, we expect most production tasks to become automated. Therefore, the actuarial workforce must begin now to shift toward continuous improvement and analysis to prepare for this eventuality. A model validation should initiate this culture change by asking model owners to think about

Figure 1
Three-Lines-of-Defense Concept in Model Validation



their models more analytically and less quantitatively. Do this by challenging model owners to document the model's "fit for purpose," develop ongoing monitoring activities like scenario or stress testing and develop validation controls to demonstrate outputs are generated from approved inputs.

## Mitigate Key-Person Risk

As members of second and third lines of defense, we are especially concerned about the preponderance of key-person risk. Key-person risk to us not only includes the risk that business processes may be interrupted due to loss of key personnel but also includes the risk that the control framework for a model is highly dependent on key persons. The former can be mitigated by developing and maintaining adequate model and process documentation. Process documentation mitigates key-person risk when it is complete such that another person with similar access to systems, models and inputs can reproduce the model owner's production results. The latter requires the holistic model validation approach to be fully mitigated. We have validated and audited models that relied on a key person as a compensating control. What does this mean? It means that the model's results were reliable mostly due to the model owner's knowledge and experience with the model. If the model owner was not present, it was likely that the results would not be reliable. Mitigation of this risk can be accomplished when model validation verifies that the model is fit for purpose, confirms presence of controls that evidence accuracy of results, verifies that documentation exists enabling a modeler to use or replicate the model and attests that there is ongoing performance monitoring to establish quality of results.

Mitigating key-person risk should have value to the model owner too. It can be challenging to get the model owner to realize the value in model documentation, process documentation and establishing controls. A model owner that has been the primary or even sole control over a model may see model validation and its requirements as diminishing their value. It is important to have success stories to share with such a model owner. The intent of model validation is not to diminish their perceived value but to unleash their true value. A successful model validation should result in releasing such a model owner from production and shifting to tasks where his or her knowledge and experience can add more value, such as identifying trends in data, optimizing model performance, modernizing the platform and developing projects to support major initiatives (e.g., regulatory development, economic modeling).

## Prepare for PBR

PBR is not just about technical changes to the valuation process. PBR requires model owners to describe all material decisions made in complying with the requirements, disclose experience study and assumption governance, and provide descriptions of approaches used to validate models. It is also likely to expect

regulators to request that models be submitted for validation. A model and the model owner will be prepared for this if they have already been through a holistic model validation and the model owner has addressed the issues and findings. Waiting until the first PBR actuarial report needs to be written will require immense struggle and effort to produce all the required documentation and evidence. If a validation effort has not been undertaken, then for some lines of business it may not be possible to comply in a timely fashion.

## Balance Costs

Value is created when benefits exceed costs. Costs vary depending on whether the model is in production or in development. We have found that, when development teams involve Internal Audit and Model Validation teams early in the process, the costs can be significantly lower. Internal Audit creates and maintains templates for model documentation, process documentation and change management (project plan, testing strategy, technical documentation and change memorandum). All of the templates comply with the corporation's model governance policy. Audit will advise the development team on how to incorporate the templates into their modeling process and consult on the overall control framework. Model Validation fills a similar advisory role but also focuses on the components of the validation that do not directly involve model governance requirements. There are marginal additional costs to have a development team member document the development process, populate model documentation and interact with Internal Audit and Model Validation.

For models in production, the costs can be significant. For instance, Internal Audit recently began a consultation with a pricing model owner who is working on becoming compliant with the model governance policy. The amount of documentation and number of new controls to be implemented will require most of the model owner's time for two to three months. Some

of the additional effort is required because some of the documentation will require locating and researching the original development effort. Documentation is best addressed during development when the information is fresh and the developer is present. Additional effort is required because some of the new controls (e.g., input and output validation) necessitate extracting and transforming model inputs and outputs. Less effort is demanded if specifications for controls are provided during development. A good analogy is wiring a house for high-speed internet. It is much more cost-efficient and requires less labor when the house is wired while it is being built compared to retrofitting an existing building.

Whether in development or in production, the costs are mostly short term, while the benefits are significant and long term. For instance, the pricing model owner can delegate much of the routine production work to actuaries in the student program, which will allow the model owner to address some enhancements and other projects. In addition, if a model is written in an older coding language exposing the area to key-person risk then model documentation will reduce the risk to nominal levels.

## OBTAINING STAKEHOLDER SUPPORT AND BUY-IN

Our experience suggests that, in order to perform a successful model validation, the validator is encouraged to obtain support for these efforts and buy-in from all key model stakeholders for the potential value and benefits they can deliver as early in the engagement as possible. This support will increase information sharing by establishing a collaborative atmosphere for interactions between model ownership, business area management and the validator; improve effectiveness of communication across these parties throughout the process; and reduce natural resistance or opposition to the validator's conclusions and recommendations.

### Ensure There is Appropriate "Tone at the Top" Regarding Validations

Clear and strong support for the idea of deep-dive validations and commitment to these efforts should be evident all the way up and down the chain of command, including senior leadership and business area management, as well as communicated widely throughout the organization. It is important that all model stakeholders are aware that the company has made a significant investment in the program with time and resources dedicated to conducting model validations. This is achieved by a series of meetings with the stakeholders during which these issues are discussed, as well as assuring stakeholders that the validators understand the extra burden imposed on model owners. Also, the potential risk management benefits from validations should be clearly outlined to illustrate the value that can be delivered to the business areas. This ensures the cooperation by the stakeholders with the validation efforts.

### Generate Shared Hopes With All Model Stakeholders About the Process

This can be achieved by developing, communicating and adhering to a consistent set of standards for validation planning, execution and results reporting.

While validation efforts, including resources and time allocation, may vary across engagements (e.g., based on each model's materiality, complexity or availability of documentation), there should be a single scale (e.g., criteria and methodology for score carding) used to evaluate and rate the models across the organization. For example, when assessing a model's fit for purpose or conceptual soundness, apply the same weights for these categories for all models. This will create a consistent mechanism to track post-validation (residual) model risk throughout the company and will also focus management's attention on business areas with elevated risk levels, having the confidence that they have undergone a uniform risk assessment.

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### Build Validator's Credibility With Model Stakeholders

This is especially important with model ownership. Demonstrate their expertise in the model's domain up front, which will contribute to building a stronger credibility for the entire program in the organization. During the initial meetings validators should describe their prior experience with the type of product and/or business process that the model supports, as well as provide professional credentials (and may even share a résumé) during the discussion. However, it is also very important for validators to be honest about any gaps in their experience or theoretical knowledge so that stakeholders can provide appropriate explanations.

Thus, during the discovery phase of the validation, frequent feedback should be solicited from model owners by asking as many questions as necessary to fully understand the model, assumptions and processes—it is better to be repetitious than misunderstand something. Ideally, in the case of hiring new talent for independent model validations, representatives of the model-owning business areas should be involved in the initial interviewing process. This can help garner maximum trust and commitment from these areas by building the sentiment of shared trust of the validator and responsibility for the success of their efforts.

### Introduce/Reinforce and Continue Driving Value of "Lines of Defense" Concept

Introducing, reinforcing and continuing to drive the value of the lines of defense concept will help institute or change and promote a culture of risk awareness and responsibility through the ranks of model-owning areas. When meeting with model stakeholders prior to beginning the validation efforts, take the time to explain the reasons for validation, its value and its direct potential benefits to stakeholders in terms of "what's in it for them," in addition to how the company itself will benefit from the project.

Since any model validation is intended as a challenge to the status quo, be prepared for some level of resistance from model ownership or business area management, at least initially. To mitigate resistance, it is useful to describe validation deliverables in terms of comfort they can ultimately provide to model owners by either confirming the model's fit for purpose or recommending changes needed to achieve it. Also demonstrate how the validators can be a valuable partner. For example, every group has projects on the back burner because of lack of resources. However, if the Model Validation team shows support for some of these projects, management may be willing to find resources, especially projects that do not add value to the company if performed by actuaries. One typical example of such process is in-force file creation. Often this is done by actuaries working with data provided by IT. Creation and control of such files are better done by IT, freeing time for actuaries to do more analysis of the results during the reporting period.

### Whenever Possible, Avoid Disruption of Business

Communicate up front the desire to avoid disruption in the daily work lives of stakeholders who will be involved in validation efforts (remember that they have deliverables of their own). Often there are system conversions taking place in the business areas, or new models being developed and implemented, which may coincide with the timing of a planned validation. For example, the new VM-20 (addressing PBR methodology) that went into effect in January 2017 for life products will probably impact actuarial reserving areas over the next three years as they update their models to comply with the new regulation. When appropriate, the validator should get involved in the testing of the new model, thus helping the owner as well as delivering on the validation objectives. When timing or resource conflicts arise, the validator is encouraged to revise the timeline if necessary. Any efforts to box the stakeholders into an unachievable deadline should be avoided, as they have their own deliverables and unexpected fire drills. Therefore, validators should ensure considerate and judicious use of the model owner's, users' and other stakeholders' time through maximum possible reliance on own experience, knowledge and efforts.

### Create a Collaborative Environment

Create a collaborative environment for the entire engagement among all parties at the very outset. A model validation's objective is *not* to look for a "gotcha" opportunity (e.g., making it a validator's goal to find flaws, errors or deficiencies), but to ultimately provide comfort to stakeholders and identify improvement opportunities. The validator can have several initiation meetings with the model owner to discuss various topics such as modeled risks, compliance with regulations or adopted industry practices embedded in the model, as well as any issues with the model itself. However, these should be intended to provide clarity and direction for the validation, rather than be used to immediately identify and point out potential problems. This approach will help build an atmosphere of trust and set the tone for the entire engagement.

Avoid duplication of efforts with other corporate entities that may be conducting parallel efforts in the same business area and even touching the same model. This will reduce the burden on the model owners and area management and eliminate the need for them to answer the same questions multiple times. In addition, model validators can potentially rely on the information (including documentation) obtained by other units reviewing the model and its environment. For example, findings and recommendations generated by Internal Audit can be referenced and/or incorporated into the validation report. It is essential, therefore, for the validator to be fully aware of all the activities taking place in the model area during the validation project, including internal and external audits, and to agree on the scope of work for each party prior to kicking off the validation activities. It is also important to communicate the scope of each function's involvement to the model stakeholders and assuage any anxiety they may have about possible undue burdens.

If an escalation is needed due to an impasse, such as a disagreement between the validator and model ownership over a finding or recommendation for mitigation, remediation or improvement, make sure that you follow the proper hierarchy of escalation. This mechanism should be agreed on and put in place up front by all stakeholders during the planning stage of the validation engagement, which will help avoid future conflicts. At the same time, a mechanism for "risk acceptance" by model owners and business area management should also be established early in the process. That is, if there is a finding or recommendation for changes that, after escalation and review by management, results in an unresolvable disagreement between their and the validator's opinion, owners and management agree to accept the risk and live with consequences of not instituting proposed changes. This should be done through a predefined process, with sign-offs by all appropriate risk-accepting parties.

## ACHIEVING CONSENSUS: ISSUES, MITIGATIONS AND FINDINGS

We believe that to ensure a beneficial impact and tangible results from a model validation, it is important for the validator to achieve consensus, where possible and appropriate, on findings and potential recommended mitigations with model stakeholders. This will help with the entire follow-up process, including verification that remediations have been implemented in a timely manner and in accordance with the recommended approach. To help with a smooth transition to the post-validation period and its successful outcome, several steps should be taken throughout the validation project:

- Build model trust, confidence and comfort through statements of confirmation (e.g., model validity, appropriateness, strong points) and/or actionable and implementable recommendations for mitigation or improvement. It does not make sense to recommend changes that, a priori, cannot be realized due to company policies, technical limitations or other factors. For example, recommending a full-blown regression testing for AG43 CTE(70) calculations is generally not feasible because of the number of scenarios involved. However, the validator can help the owner to pick several (between 3 and 10) scenarios on which regression testing can be performed.

- Maintain stakeholders' goodwill by driving and managing project deliverables and communication through appropriate channels (e.g., do not point out any discovered errors or inefficiencies to management before presenting findings to the model owner). The validator should discuss all findings with the model owner, because sometimes the validator may be wrong about an error and sometimes the error is in the model because of system limitations. For example, the annuitization benefit stream may be excluded from the BAR calculations. This should be OK for CFT or C3P1 models because of immateriality; however, it would be wrong in AG43 models.

- Deliver full transparency of all validation efforts through frequent communication throughout the validation engagement. There should be no surprises in the final report. Ensure consistent communication of objectives to all stakeholders and avoid conflicts due to misunderstandings. Ensure that the final objective is independent, fair and documented in an unbiased model validation report.

- Build reliance on the validator's opinion by only presenting actionable (i.e., realistic and implementable) recommendations. Variable annuity hedging is a very complicated process. AG43 models often simplify the hedging in order to save time. In such cases, the modeler should discuss appropriate changes to the hedging that will improve the model's results without making the cost of running it prohibitive.

- Provide a fully documented and shareable record of all steps taken to validate the model. It should include a comprehensive final model validation report containing feasible, practical and actionable recommendations in line with industry best practices.

- Ensure stakeholders' involvement with proposing recommendations for remediation, enhancements, process improvements and implementation of best practices. Soliciting opinions on mitigation and process improvements will empower stakeholders and help with buy-in.

- Be prepared for dealing with a "we have always done it this way" attitude. Recommendations should focus on improvement rather than disruption of existing processes; recommendations should be framed as mutual benefits for all stakeholders, business processes and the organization as a whole. Be skeptical of responses such as "it is company policy." The policy may have existed at the time of model development but may have changed over time and without being reflected in the model's functionality. Often during conversions full assumptions testing is not done; it was seen as unnecessary since the results "matched our expectations" or "we validated them visually." The validator should stress the need for thorough testing and, if needed, help the model owner to set up such process.

> Use model validation to help transform your company's culture from a routine task-oriented one to a value-add and analytical one.

It may be prudent to establish a mechanism whereby Internal Audit takes an active part in managing post-validation deliverables, as they often have the infrastructure and tools to track and guide post-audit actions. Model governance should play the main role, however, in tracking major themes emerging from validations and providing communication among business areas if common threads (e.g., trends) are observed or new ones are emerging. This may help streamline mitigation efforts and achieve consistency (e.g., identify common assumptions that can be single-sourced by multiple areas, if feasible, or frequently repeating failures, errors or issues, which may be an indication of a larger systemic problem).

Put together detailed post-validation risk mitigation, remediation and improvement plans and obtain full sign-offs from all stakeholders; implementation of mitigations and recommendations should be carefully managed, with clearly identified deliverables, timelines, follow-ups and communication. Validation should also be followed up with education and socialization of learnings throughout relevant business areas and establish framework for future validation efforts.

## WHAT SHOULD YOU DO?

Is there a sense of urgency around model validation at your company? Consider the value that can be added by undertaking a holistic model validation approach led by people who have an appreciation for how it can add value and are familiar with the development life cycle and model governance. Leverage your current workforce and utilize a multipronged effort among first, second and third lines of defense. Do not dampen long-term benefits by using the authority you have most likely been given to tell validators and model owners to "just do it." Instead, establish shared hopes to drive results.

Most of all consider how the number of routine jobs in our economy is decreasing and use model validation to help transform your company's culture from a routine task-oriented one to a value-add and analytical one.

At MassMutual, we embraced the holistic approach to model validation, and the first, second and third LODs work collaboratively. The second LOD (risk management) and the third LOD (audit) work in unison to assess compliance with model governance policy and assist model owners in getting into compliance. The first LOD (model owners) realizes that the components required by a model validation can best be addressed during the development phase and seeks out our involvement in model conversions and development projects. Model validation is no longer being viewed as "overhead" but as something that adds value. ■

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### ENDNOTES

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