



Article from

**The Modeling Platform**

April 2018

Issue 7

# Hand Over, not Fall Over: Focus on Actuarial Model Handoff From Development to Production

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Whether it is a simple Excel formula-driven spreadsheet or a complex stochastic model calculating variable annuity projections under thousands of scenarios, actuarial models go through multiple distinct stages in their lifetime. Collectively, these stages are commonly referred to as *model life cycle*. From scoping and planning to model retirement, multiple modelers and model users build, run, modify, validate and archive actuarial models.

There are typically model governance policies that dictate the roles and responsibilities of each of the individuals and teams interacting with models. These critical policies are in place to govern various modeling processes and help ensure model sustainability through the various stages and transition points in the model life cycle.

One of the most delicate transition points in the model life cycle that often requires special attention and unique considerations in the model governance framework is the model handoff from development team to production team. While a handoff is typically thought of as a relatively quick exchange or transaction, a successful model handoff from one team to another is often an extended process that could take months from start to successful completion. The initial model handoff from development to production occurs once the core model build is complete and the model is tested, reconciled and validated. However, throughout the production stage the model typically transitions as often

as quarterly between development and production teams as ongoing model modifications and updates resulting from introduction of new products, regulatory changes, refinements of modeling approaches and ongoing model updates are required. A successful handoff allows for easier, more streamlined model maintenance processes in the short term; but more important, it significantly reduces model risks and contributes to extended model sustainability in the long term. This article will discuss key considerations to take into account while planning for and executing the initial model handoff from development to production.

There are many modeling team and environment structures that exist across the insurance industry today. To level-set, we would like to illustratively define key responsibilities of the development and production teams throughout the model life cycle. At a high level, the two teams can be differentiated as modelers (development team) and model users (production team). Modelers are responsible for creating, updating, testing and releasing the actuarial master models into a locked-down production environment. These are individuals with deep technical knowledge of the modeling tools, model architecture components and modeling approaches used. Model users are responsible for updating the model with current data, running the models, and producing and analyzing results. Model users typically belong to the companies’ financial reporting departments, and their focus is on model results rather than on the technical aspects of the model. Figure 1 illustratively summarizes responsibilities of the development and production teams for a typical two-team modeling environment.

There are many ways one can approach the model handoff process discussion. The framework proposed in the article focuses on six key components of the model management process and discusses each of these through the lens of a three-step process. While some overlap in activities exists across its various components, this framework should be viewed as a holistic three-step process to manage the handoff process. The six components of the model management process are:

- **Model governance policies and standards.** Policies and standards that can be applied consistently to various modeling activities. These policies should guide modeling decisions and model management activities throughout model life cycle.
- **Model structure.** Models should be transparent and easy to follow with built-in flexibility to accommodate future changes. Subsequent model updates should result in minimal changes to model infrastructure. Modular model development generally tends to result in more sustainable model structures than linear model development.

Figure 1  
Illustrative Responsibilities of the Development and Production Teams

| Development Team                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Production Team                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
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| <p><b>Modelers</b>—Individuals who create, update, test and release actuarial master models</p> <ul style="list-style-type: none"> <li>• Driven by the model steward</li> <li>• Build, update and release master models</li> <li>• Test the model and report any inconsistencies</li> <li>• Use the modeling platform functionality as specified in technical and business requirements</li> <li>• Use model-adjacent technology as specified in technical and business requirements</li> <li>• Have the model peer-reviewed and ensure controls are in place to catch unintended changes to the model</li> <li>• Periodically validate the model to ensure model functions as intended</li> </ul> | <p><b>Model users</b>—Individuals who run the production models to produce and analyze results</p> <ul style="list-style-type: none"> <li>• Driven by the managing valuation actuary</li> <li>• Check out a copy of the master production model</li> <li>• Communicate with the development team regarding model updates to agree on approach for modeling updates consistent with model architecture</li> <li>• Manage the production environment and control user access</li> <li>• Validate model inputs and model outputs for production cycles</li> <li>• Run production models and consolidate results</li> <li>• Analyze model results</li> <li>• Archive production versions of the models following production runs</li> <li>• Communicate with development team to make updates to the master model consistent with the latest updates made to production copy</li> </ul> |

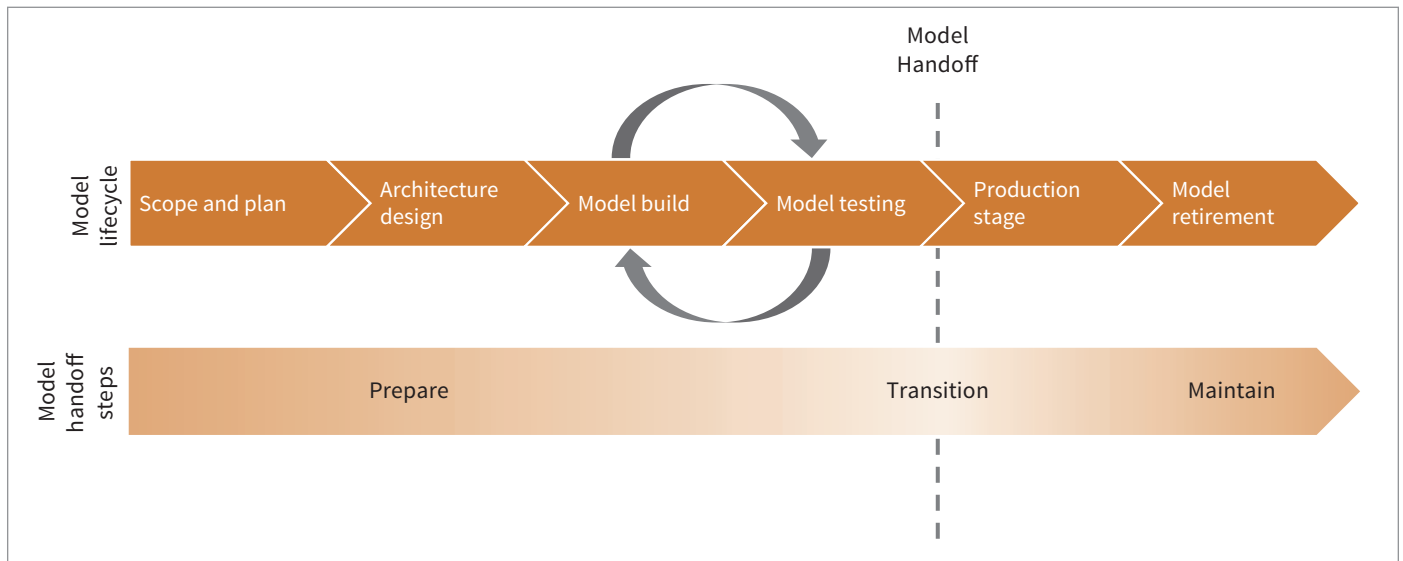
- **Data.** Complete and accurate data should be used in the model. Controls over data should be embedded in the production process, and any deviation in data quantity or values from expectation should be explained. Both input and output of the model should be considered under this component.
- **People.** Both the development team and the production team should have the required technical skills for their roles and good understanding of each other’s responsibilities.
- **Controls.** Functional and effective model controls over data and calculations facilitate model transparency and provide additional confidence in model output.
- **Documentation.** Sufficient and relevant model functionality documentation helps users understand the model, run routine processes and debug the model with minimal additional guidance. Technical model documentation focuses on model architecture, modeling approaches taken and issues tackled during model build, and describes any model limitations and approximations made within the model in question.

For each of the components of model management, a three-step model handoff process can be defined to facilitate a successful model handoff from development to production. As shown in Figure 2, each of the steps should be sequentially considered and executed in accordance with model governance policies within the organization. The model handoff steps follow the model life cycle stages and can be classified as prepare, transition and maintain.

1. **Prepare.** This step should commence at the start of model life cycle, during the scoping and planning phase. It should address items like consistency in model build, naming convention, development documentation and other artifacts that will benefit the handoff process. In the event that relevant preparation activities do not take place throughout the development phase, it is often more challenging and time-consuming to carry out these activities at the time of transition.
2. **Transition.** This step is a pivotal step that will help determine key guidelines and activities for future model runs, updates and troubleshooting. This is a communication-heavy step, during which discussions between development and production teams should take place to help the production team get comfortable with the model structure and related processes. A smooth transition phase results in streamlined and effective model maintenance activities in the future.
3. **Maintain.** If sufficient preparation takes place and the transition step is successfully carried out, model maintenance should be a streamlined, mostly automated process with minimal incremental effort from the production team. Model updates should be carried out consistently across model components and over time.

The remainder of this article expands on each of the model management components in detail by discussing the activities throughout the three-step handoff process for each of the components.

Figure 2  
Three-Step Initial Model Handoff Process



### MODEL GOVERNANCE POLICIES AND STANDARDS

Model governance policies and standards will define the processes around model development and management. These policies should be developed and enforced by the model steward team and should be periodically updated to remain current. Established model standards should guide the development team in taking a consistent approach to model development and updates, which in turn can make it easier for the production team to quickly identify, review and get comfortable with the updates. Model governance should focus on routine and ad hoc production processes defining model ownership and other responsibilities, model update processes, change management protocols, and model testing and documentation procedures. The benefit of model governance policies and standards is model transparency and consistency, both within model components and across models. Transparency and consistency in modeling approach would significantly streamline and ease the model handoff process.

- **Prepare.** Model standards should be developed and discussed prior to start of the development phase. These should be top-down standards, originating in the business and technical requirements for the model. The development team should design model architecture and make modeling decisions based on the standards throughout the development phase. Model standards should guide future model modifications and updates, resulting in a consistent approach to modeling across the entire model life cycle.

- **Transition.** For the transition phase, model governance policies should define model reconciliation standards and thresholds, user acceptance testing, parallel runs requirements and embedding of the model into the production environment. They should define the production acceptance criteria and process and the protocol for communication between development and production teams when additional model build efforts are required.
- **Maintain.** Model governance policies should help guide the model maintenance procedures. These policies should define model update processes, change management protocols and model update documentation requirements. They also should clearly define model ownership and other model-related responsibilities and sign-off processes for model management activities including model runs, updates and troubleshooting. Model governance and standard policies should be continuously reviewed and updated as needed to keep them current and applicable.

### MODEL STRUCTURE

Model structure would directly impact model sustainability and ease of running, updating and troubleshooting the model. Model structure would include elements like consistency in modeling approaches, automation and efficiency of modeling processes, leveragability, and auditability of the model and its components.

- **Prepare.** Effective model structure begins with model architecture design. Model design should be consistent in intent

and execution throughout various modeling approaches within a single model and also across different models. The development team should have recurring discussions with the production team to identify opportunities to automate current processes and subsequently minimize possible human errors. The development team should focus on increasing efficiency in model design by ensuring the model contains only the components that are being used in model runs. This would eliminate unnecessary model rework and reduce model size and runtime. In order to increase model sustainability, the development team should consider model leveragability and ease of modifying existing and adding new model components throughout this step.

- **Transition.** During the transition phase, the production team should be trained on the model structure and the impacts of change in various model components on model execution and results. Supporting documentation on model architecture and modeling choices should benefit the production team greatly in understanding model design.
- **Maintain.** The master model structure should remain locked down in the production environment. Unless a structural change has been explicitly approved following the governance policies, model structure should remain intact. Model review and validation should be done periodically, especially when new and significant changes are implemented, to ensure the model structure and its components remain functioning as intended.

## DATA

Accuracy and completeness of model data will have a significant impact on model sustainability in the production environment. Ideally, by the time the model is moved to a production environment, all data sources, destinations and formats should be finalized. These should remain locked down in the production stage, unless an explicit approval has been given for structural changes in model data. Both input data and output data should be considered as part of this component.

- **Prepare.** All model data should be reviewed by the development team to determine the fields to be brought into the model and their respective formats and limitations. These should be clearly defined in the model as input fields and documented in a data dictionary. Data processes within the model should be clearly defined by the development team to support production processes. The development team should also make an effort to understand the production team's downstream process and be aware of data elements that the model should output into the financial reporting process data repository. Understanding the required output

should help companies optimize data processes within the model and eliminate manual processes and adjustments external to it.

- **Transition.** The responsibility for model data processes should be transitioned along with the model to the production team, as the production team will become the owner of these processes following the transition. All input data should be validated in the production environment and reconciled against the data previously used in the development environment. Test protocols focused on model output should be established to assess its compatibility with the downstream processes and reporting tools should be confirmed. The production team should identify their contacts in the administration and IT teams to support their data needs in the future.
- **Maintain.** Data validation should be conducted with every data update to ensure completeness and accuracy. Evolving data business requirements and any changes in data sources or formats should be monitored periodically. Automated controls over data should be established to alert the production team of any unexpected results.

## PEOPLE

Having a balanced skill set within the respective teams is key to improving model sustainability in the development and production environments. The two teams have to “speak the same language” and understand each other's goals, processes and challenges. Often other functional areas, like IT, are involved in the production process—they too need to be on the same page with the actuarial teams responsible for the model.

- **Prepare.** It is beneficial to include the production team in the early communications of the development process, if possible. Periodic high-level discussions around project status, potential limitations of the model, as well as modeling decisions made throughout the development process would help the production team start building a high-level perspective on model functionality and limitations.

It is valuable to have both a technical expert and an institutional guru on the development team. A technical expert can foresee obstacles or complications in the modeling process and help the team prevent these. An institutional guru can bring the product- and company-specific knowledge to the project and work closely with the team to make sure complex product features and regulations are modeled consistently with company guidance.

- **Transition.** Model overview and production run training should be provided to the production team assuming

responsibility for the model. Rotation of one or more individuals from the development team to the production team can facilitate the learning process.

- **Maintain.** A development team contact should be available to the production team in order to support production processes, at least for the several initial production cycles. Ongoing involvement of the development team should include routine model updates and enhancements and support, as well as ad hoc model change tasks as needed.

## CONTROLS

Model controls are key to ensuring the model produces appropriate calculation results. Controls are critical to long-term model sustainability and should be embedded and automated as part of the modeling process. There are multiple layers of controls that should be implemented and maintained throughout the model life cycle. Control layers will include access controls, controls over data, controls over calculations and error handling controls. Control guidance should be part of model governance policies and should be maintained and updated as the model changes over time.

- **Prepare.** The model should be built in a transparent way with accompanying documentation outlining the model control framework. Controls over data should validate that the data fed into the model is reconciled with the appropriate data source. Controls over calculations should be set up both at the policy level for a subset of select test policies and at an aggregate level. Error handling controls should be designed to consider the magnitude of error and its impact on model results.
- **Transition.** Control documentation should be delivered to the production team accompanied with control walk-throughs and training on calibrating controls and reviewing their outputs. Access and read/write controls should be reviewed and approved and assigned to individuals or groups interacting with the model at various capacities. User groups should be set up, allowing unique access privileges for each.
- **Maintain.** Model controls should be reviewed for effectiveness and updated as needed periodically. As new product features and model components are added, additional controls may be required to be added to ensure effectiveness of the overall control framework.

## DOCUMENTATION

Documentation is a valuable artifact to facilitate the handoff of the model to the production team and model maintenance from that point on. There are multiple components to model documentation; each of them is important on a stand-alone basis,

each for its own purpose. Some documentation can become outdated, and it is important to keep documents updated for model changes following the handoff.

- **Prepare.** The documentation process should begin at the start of the development phase and evolve as development progresses. Primary documents and secondary documents should be identified and separated during the process. Primary documents will remain applicable in the production phase and will continue to be used and routinely updated, while secondary documents are static documents from the development phase, used as sources of additional supplementary information.
- **Transition.** Documentation handoff should accompany model handoff. The development team should ensure that all documents are up-to-date at the time of handoff. A documentation walk-through of the available documents is often beneficial during the transition step.
- **Maintain.** The production team should own the documentation and make necessary updates as the model is updated and run over time. Model documentation types and templates should be included in the model governance policies for the company. Model documentation should reside in a centralized location and be protected from unintended changes.

A successful model handoff process should address all of the model management components in its design and execution—model governance and standards, model structure, data, people, controls and documentation. This is a systematic approach that spans from the very early stages of scoping and planning and concludes when the model is retired. It requires close collaboration between the development and the production teams throughout the model life cycle in order to facilitate appropriate knowledge transfer. In the event that the model handoff is not successfully executed, complications in production modeling processes may arise, which in turn would result in additional risks and costs to the organization. ■



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