Ten Best Practices for an Effective Model Risk Management Program

A QuantUniversity Whitepaper

By

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Introduction:

Model risk and the importance of model risk management has gotten significant attention in the last few years. As financial companies increase their reliance on quants and quantitative models for decision making, they are increasingly exposed to model risk and are looking for ways to mitigate it. The financial crisis of 2008 and various high profile financial accidents due to model failures [1, 2, 3] has brought model risk management to the forefront as an important topic to be addressed. Many regulatory efforts (Solvency II, Basel III, Dodd-Frank etc.) have been initiated obligating banks and financial institutions to incorporate formal model risk management programs to address model risk. Regulatory agencies have issued guidance letters and supervisory insights [4, 5] to assist companies in developing model risk management programs. In the United States, as the Dodd-Frank act is implemented, newer guidance letters [For example, 6] have been issued that emphasize model risk management. Despite these efforts, in practice, financial companies continue to struggle in formulating and developing a model risk management program. A lot of companies acknowledge and understand the model risk management guidelines in spirit but have practical challenges in implementing these guidance letters. In our prior article on model risk [6], we discussed many drivers to address model risk and challenges in integrating model risk into the quant development process. In this article, we will discuss ten best practices for the implementation of an effective model risk management program. These best practices have evolved from discussions with industry experts and consulting projects we have worked with in the recent years to create robust risk management programs. These best practices meant to provide practical tips for companies embarking on a formal model risk management program or enhancing their model risk methodologies to address the new realities.

1.   Adopt a Framework-Driven Approach for Model Risk Management

A model risk management program must obtain company wide support and buy-in from all stakeholders engaged in model development, use, validation and compliance for it to be successful. Adopting a framework-driven approach ensures that all elements of the model risk management program are defined clearly before embarking on a companywide initiative. This includes identification of the stakeholders, identification of the models and the methodologies involved, review of the model development lifecycle and review of existing company policies and regulatory requirements that need to be followed. The three minimum things a model risk management framework should incorporate include:

1.   **Model Governance structure**: Addresses regulatory requirements, roles, responsibilities, oversight, control and escalation procedures
2.   **Model Lifecycle management**: Addresses the processes involved in the design, development, testing, deployment and use of models. Also addresses testing and documentation plans and change management.
3.   **Model Review and Validation Process**: Addresses internal and external model review, validation and ongoing monitoring of models (both qualitative and quantitative)

Defining a framework ensures appropriate bucketing of tasks and in ensuring a structured approach to developing a model risk management program.

2. Customize a Model Risk Management Program

An additional advantage of a framework-driven approach to model risk management is that the program can be customized to the institution's needs. Every organization is different. The size, structure and the activities an organization engages in, generates different levels of risk exposure. In addition, every company has its own company culture and core-values and adopting any new company wide initiatives is challenging. Adopting a model risk program could change the way models are developed, governed and used in an organization. Quant departments may feel that a model risk program's need for structure, transparency and oversight imposes constraints and overheads that didn't exist before. To ensure the success of a model risk management initiative, the program should be customized considering the structural aspects along with the nuances specific to the organization. This doesn't mean diluting the requirements of the model risk management program. Customization requires effective engagement of all stakeholders and an internal agreement to the spirit of model risk management. Recognition of the need to incorporate changes to existing model development methodologies and buy-in from all groups is needed to reduce potential friction between departments. We recommend companies to take a holistic approach to ensure that the model risk management principles and regulatory requirements (See the Supervisory Guidance on Model Risk Management [4]) are effectively incorporated in a model risk management program that is customized to the organization's needs and structure.

3. Clearly Define Roles and Responsibilities

A framework-driven approach to model risk management also facilitates clear articulation of roles and responsibilities of all stakeholders. Note that a company-wide model risk management program should engage all stakeholders, from those who are responsible to design, develop and use the models to those who are in a supervisory capacity and are accountable for the models. The OCC supervisory guidance [4] discusses the notion of an "*effective challenge of models*" which it defines as "*…the critical analysis by objective, informed parties who can identify model limitations and assumptions and produce appropriate changes*". In order to facilitate an objective and independent assessment of model risk, organizations must set up structures to segregate groups engaged in the design and development of models from groups who are responsible to pose an "effective challenge" through model review and validation activities. As per the Supervisory Guidance on Model Risk Management [4], key considerations for effective challenge includes incentives, competence and influence. To create a structure within the organization that would make an "effective challenge" feasible, senior management must be engaged and must provide the budget and resources to ensure sufficient delineation of responsibilities and the operational and governance structure needed to implement a model risk management program. At times, an organization may not have the expertise in model risk management and resources to take on roles to facilitate an effective model risk management program. Committees need to be established to facilitate decisions. Organizations may also have to make changes in the organizational structure to create roles for model risk and validation related responsibilities. For organizations embarking on new model risk management initiatives, internal model risk expertise may not be available and external candidates, who have experience in model risk, may have to be hired to facilitate model risk programs. In those situations, external model validators could fill the gap in facilitating model review and validation. They could also provide the best practices needed to structure and enable a model risk management program (See [8] for our example offering) for the long run.

4. Integrate Model Risk Management Effectively Into the Model Life Cycle

The lifecycle of a model (See Fig 1) begins at its conception (requirements drawn from a methodology), prototyping, testing, documentation, review and validation, production, ongoing monitoring and model enhancements (or retirement if it has met its purpose). The goal of model risk management is not to have an additional step in the model life cycle as a gating process for model approval (approve/not approved) before releasing a model to production. Since model risk drivers are permeated throughout the model life cycle, for effective model risk management, the model life cycle must integrate model risk processes (needed to check the validity and effectiveness of the model) into the model life cycle. Many a times, model risk management is bundled into the model review and validation step in the model life cycle and models are submitted to the model validation team for review and validation after the model is completely built. Since many model risks can be effectively identified and mitigated (through addressing of the issue or by putting controls in place) during the model development process, the model development and use guidelines must integrate measures to address model risk in every step of the model lifecycle.
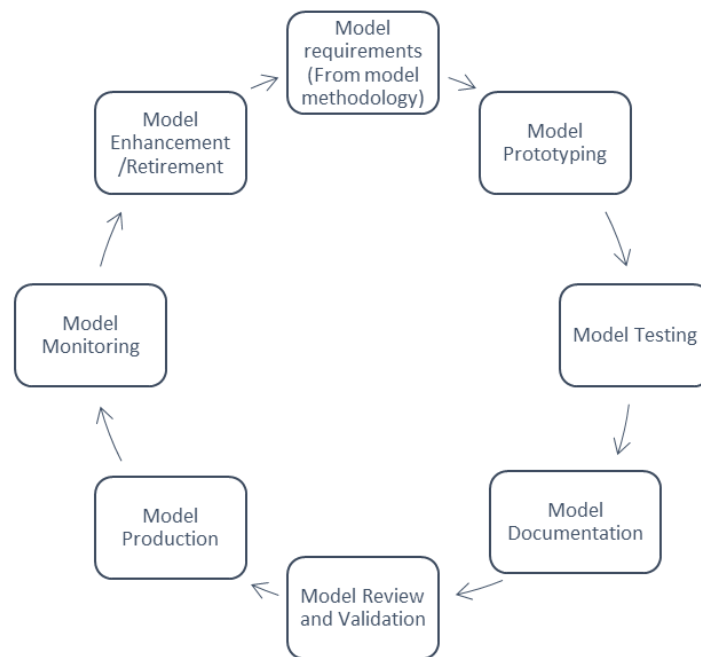
Figure 1: Model Lifecycle Management

5. Don't Reinvent the Wheel

Some of the best practices in model risk management has been in vogue in other areas for decades. In our last article [7], we discussed an approach to quantify model risk. A similar approach for quantifying environmental risk was used when I was an engineering trainee in a company that manufactured hydraulic excavator in the in 1990s. As a part of ISO 14001 certification, we were quantifying and putting controls in place to mitigate the risk of phosphate sludge entering storm water runoffs. The point is, model risk management practices are not new and we should leverage and augment the best practices from other areas rather than reinventing the wheel. For example, many IT groups would already have the infrastructure and established processes for software development. These would typically incorporate software development best practices for security management, change management, configuration

management, testing, logging, archiving etc. Rather than creating new processes and standards for quantitative models, existing methodologies can be integrated into the model lifecycle, effectively creating robust practices for development and to control risk. We advocate engaging IT departments in your companies as an important stakeholder to leverage their experience and best practices in developing a model risk program.

6.   All Models Weren't Born Equal

As per the Supervisory Guidance on Model Risk Management [4], a model is defined as follows:

"Model refers to a quantitative method, system, or approach that applies statistical, economic, financial, or mathematical theories, techniques, and assumptions to process input data into quantitative estimates".

An organization may have models that may be simple spreadsheets to models that may be complex and require simulations and optimization routines for implementation. Some models may be homegrown (internally developed) and some models may be sourced through consultants and vendors. The model development methodology may require models to be prototyped first in 4th generation languages like MATLAB, R or Python and then translated to C/C# for performance. Models may run standalone on desktops or may have be deployed onto servers. Considering all these possibilities, it is impossible to have one standard for all models. We advocate categorizing the models in the model inventory into classes and have a class-based model policy for model risk management. In the consulting projects we have worked on, we typically create an inventory of models and segment and score models based on criteria such as complexity, dependencies, impact, maturity etc. We then categorize them into classes (Class 1, 2, 3 etc.) and formulate policies or model risk procedures for each class of models. The criteria for classification depends on the kind of models a company uses for decision making and has to be done after a thorough understanding of the context and model use-cases.

7.   A Checklist Is Your Friend

Atul Gawande's best seller 'The Checklist manifesto' [9] discusses and advocates the use of simple concept of checklists that enables doctors handling complex cases develop treatment plans effectively. Doctors work in extremely stressful situations and a simple mistake could cost human life. Incorporating checklists increases efficiency in the process and allows doctors to focus on important decisions while relying on checklists for protocols to be followed. We advocate using checklists throughout the model risk management program. Checklists ensure that the process is documented and quants have a repeatable and reliable process to follow when developing models. They provide traceability and reliability to processes and helps meet documentation and archiving requirements in model risk management programs. In addition, checklists ensure that risk mitigation controls can be triggered systematically, when models aren't performing as per expectations. Checklists also help in finding gaps in the process and helps improve the robustness in processes. Having checklists to follow when a model is unusable either due to model specific issues (such as model crashes/software bugs) or when there are external adverse/unpredictable events (market crashes/ geopolitical events etc.) is extremely useful. It can provide departments, a structured way of implementing policies during stressful and unpredictable situations to ensure business continuity. We advocate building checklists and templates in each step of the model lifecycle and review and validation steps to enhance the robustness of the model risk program. An inventory of checklists and templates ensures that the process is standardized and a systematic approach to model risk management is followed, helping model review and validation efforts.

8. Monitor the Health of the Models and the Program

Ongoing monitoring is a critical piece of a model risk management program. As the old management adage goes, "You can't manage what you don't measure". Model risk management is an ongoing process and is not limited to periodic model checks or exception handling. The models in use should continually be monitored and as time passes, the models may have to be recalibrated to accommodate new market or business conditions. The assumptions incorporated in a model may no longer be valid and models may not perform as designed. In addition, errors may be uncovered and new business requirements may be needed. We advocate defining a thorough process for measuring and monitoring the health of the models. Systems and processes to document observed changes in model behavior and risk characteristics must be defined and tested as a part of the model risk management program. Periodic reviews (at least annually) of the health of the models must be conducted to ensure that the model characteristics are acceptable. If the model performance is deemed unacceptable, or if the model risk has changed, suitable measures must be incorporated to ensure that the risks are mitigated. Appropriate escalation procedures must be documented and roles identified to ensure that the risks are communicated through proper channels.

9. Leverage Your Domain Knowledge on the Models

Ultimately, you know more about the models you use than anyone else outside your company. A model risk management program is successful when an organization is involved throughout the lifecycle of model development and understands the implementation thoroughly to put together a model risk program in place. It is a common practice to engage consultants and vendors to help build your models. Though this may be inevitable (For example, when you are working with a new vendor or don't have the expertise to build your own models), we advocate training and ramping up of internal resources who can be fully engaged in the model lifecycle. You know your models best. Vendors and Consultants may not have the domain experience especially if they sell platform products which support multiple domains. I once worked with a consultant who wanted help with a "VAR" model. When I asked whether it was the Vector autoregressive model or Value at Risk Model, he wasn't sure which one it was. I worked with another engineer who developed a function called "getGreeks()". This function took one input and returned one of the Greeks. Unfortunately, the input variable was encapsulated in another object and till you manually debugged the code, you would have no idea which Greek was returned as an output. When vendors/ third party consultants provide minimum documentation and don't have the required domain knowledge, it is the responsibility of the model development group to set expectations and standards for the models being built for them. Even if you use models developed by vendors, you are ultimately accountable and need to put together a thorough plan to ensure that the vendor models are tested prior to deploying those models into production. We advocate noting dependencies for each model in your inventory and ensure you have a thorough plan in place when leveraging vendor or third party developed software.

10. Own the Model Risk Management Program

Initiating a model risk management program is not about satisfying regulators or external validators or even just the model validation group in your company. A systematic approach to Model Risk Management not only mitigates risk but provides a source of competitive advantage. Owning the model risk management program and integrating it as a part of the model life cycle ensures that the adverse effects due to model failures can be mitigated, especially during unpredictable and stressful situations. It also creates a transparent and resilient model development framework and creates awareness within and outside of the model development group on the state of model development and helps plan strategic changes to the model development and validation processes. In addition, an enterprise-wide model risk

management program with full support from senior management demonstrates commitment and seriousness towards creating an effective model risk methodology. A sense of ownership amongst various stakeholders aligns stakeholders to not only adhere to the requirements of the program but also to proactively engage in continuously improving the program to make it more robust.

Conclusion:

Model risk management has recently gained significant attention in financial institutions. Initiating and adopting a model risk management program can be daunting considering the lack of established best practices and limited guidance available to institutions. With new regulations mandating strict policies to address model risk, institutions are required to initiate formal model risk management programs. As more and more companies are embarking on model risk programs, it is essential that they consider some of the best practices and successes other organizations have had before embarking on a companywide model risk management initiative. In this article, we have highlighted ten best practices, institutions should consider when designing and implementing a formal model risk management program. These best practices have evolved from discussions with industry experts and practical experience gained through working with multiple customers. By incorporating these best practices, companies can develop a robust model risk management program that provides a strong foundation for model lifecycle management while effectively addressing the challenge of model risk.

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About:

QuantUniversity offers quantitative modeling and consulting services to financial institutions. QuantUniversity recently launched a new offering called **"Model Risk Review and Validation Service"** and offers training and custom consulting packages for model risk management.

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For a copy of sample templates quants can use for model risk management, contact Sri at sri@quantuniversity.com