

**Model Documentation for Tier III & Tier IV Models**

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| --- | --- |
| **Inventory Name:** | Inventory Name |
| **Inventory ID:** | Inventory ID |
| **Owner:** | Inventory Owner Name |
| **Owner Group:** | Inventory Owner Group |
| **User Groups:** | Inventory User Name |
| **Model Developer:** | Model Developer Supporting the Process |

**Template Guidance**

* This is a generic template for KeyCorp **Tier III and Tier IV** models. The objective is to provide a common structure and content on documentation.
* Statements and conclusions should be supported with factual information, e.g. tables, charts and exhibits.
* Vendor model may have proprietary restrictions, resulting in lack of transparency in compliance with the requirements in this template. Such limitations should be documented and mitigations should be in place to ensure model meets business needs.
* **NOTE:** Please remove red text template guidance throughout as documentation is completed. To remove the highlighting in the editable sections after the completion of the template, in the menu bar at the top, please go to the **“Review**” tab, click on “**Restrict Editing**” in the tool bar, and uncheck the box of “**Highlight the regions I can edit**” on the right-hand side tool bar that comes up.

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1. **Executive Summary**
   1. **Model Overview**

This section documents the model’s purpose and specific use. It should provide informed parties with sufficient details to have an understanding of the model.

1. ***Intended purpose of the model***

This section should document the model purpose related to the business needs, e.g. model is used for consumer personal unsecured portfolio origination.

1. ***Intended model scope of application for business need***

This section should define the scope of the model, ensuring that the scope is aligned with the business needs. For example,

1. What is the portfolio impacted by this model (e.g. Commercial vs. Consumer, portfolio size $/count, products, origination vs. portfolio management for booked exposure, and geographic concentration etc.)?
2. What are the management decisions driven/impacted by the model?
3. ***Applicable regulatory requirements and KeyCorp internal policies, procedures, standards with relevant sections referenced***

What are the regulatory requirements and KeyCorp’s policies/procedures/standards that are applicable to the model? Document the relevant sections of specific regulatory and KeyCorp requirements. An example of the regulatory requirement is Fair Lending regulations.

* + 1. ***Model Limitations – Description, Impact (CCAR / other uses), and Mitigating* *Factors***

What are the model limitations? In the context of a redeveloped model, what are the known limitations and outstanding model risk findings of the prior model? If a new model is being developed, what are data limitations and the weakness of the selected modeling approach?

Given model weakness and limitations, what are mitigations established to address them? Examples of mitigations are restrictions on the model use, overlays or adjustments to model outputs and/or frequent monitoring of model performance.

* + 1. ***Requirements of model output, including downstream models, processes and reporting***

What is the downstream impact of the model, from process and reporting perspective? For example, how does the model impact underwriting process or regulatory reporting, if applicable? If the model is used for underwriting, is it the sole process to drive decision, or is it to be combined with other processes?)

What is the granularity of model output (e.g., loan-level vs. segment-level vs. portfolio-level) and frequency of output (e.g., monthly vs. quarterly vs. annual)?

* + 1. ***Primary Model Stakeholders***

Who are the model owner, model user, model developer of the model?

What are the owners of upstream feeder model and downstream model that uses this model’s output?

Who is the vendor(s) if vendor model? What is the reputation of the vendor?

1. **Appropriateness and Integrity of Data**

This section documents the integrity of data used for model development. What is in scope is data used to build, test, and calibrate models *before* implementation, not production data *after* implementation.

1. 1. **Appropriateness, Completeness, and Accuracy of the Input Data**
      1. ***Data Sources, Cross-Section/Time-period of data, and Appropriateness of Data (Standards 7, 8, 9, and 10)***

This section should articulate why data is suitable for the model. Data quality focuses on completeness, accuracy and representativeness.

Data Completeness:

* What is the data source, i.e. internal or external? What systems is data pulled, if internal? Is data qualitatively derived, Yes/No? If data is qualitative derived, how is it generated?
* What is the time period (e.g. Jan. 2006 to June 2017) and frequency of data pull (e.g. monthly vs. quarterly)?
* How complete is the data? All available data for the portfolio or a sample? What is the evidence that there is sufficient number of records to build the model?
* Are there any concerns on missing values or outliers? If so, how are missing values and outliers handled?
* Is data proxy used Yes/No? Describe data proxy if applicable.

Data Accuracy

* If internal data, how data is reconciled with KeyCorp’s official source, such as General Ledger?
* If internal data, are there any concerns on data quality due to historical IT system conversions? If so, how is the issue mitigated?
* For data that is not sourced from an official KeyCorp source, articulate why the data is appropriately tested and could be used for business decision making.

Data Representativeness

* If internal data is used, how representative is it of KeyCorp’s portfolio?
* If external data is used, what is the evidence of its applicability to KeyCorp’s portfolio?
  + 1. ***Data collection and cleaning procedures applied to data (Standard 11 and 13)***

This section should document how raw data is processed into final model development data, such as data merging conditions, treatment of missing values and outliers, transformation, filtering, exclusions, and exceptions. For example, missing values for variable X are inputted with median values from the modeling sample is an effective way to document missing value treatment.

* + 1. ***Data sampling techniques (Standards 12)***

This section should document sampling methods, if applicable, in constructing the final model development dataset.

1. **Conceptual Soundness**
2. 1. **Model Design and Segmentation**

This section is to document the assessment of the modeling approach /theory and review of the model developers’ and businesses’ support for model design and segmentation.

* + 1. ***Review of model approach, specification, assumptions/limitations, and development data (Standards 14, 15, and 16)***

Document approach, including:

* Evidence of research/industry practice to support the chosen model approach. If it is a vendor model without transparency, document this as a limitation.
* Describe major assumptions of the model. If vendor model, document the limitations if model assumptions are not transparent due to proprietary restrictions.
  + 1. ***Appropriateness of development data, model complexity, feeder models, and model segmentation for model use (Standards 17, 18, 19, and 20)***

What is the evidence the model is appropriate in addressing the business needs? This includes:

* Document the appropriateness of data given business purpose and model complexity. This justification should take into consideration some of the data quality characteristics described in Section 2.
* Describe segmentation of the model, if applicable, and business insight to support the segmentation (For example, line of business recommends the segmentation due to credit risk profile.
  1. **Parameterization**

This subsection documents the statistical, economical, and business intuition in order to derive parameters in the final model. For example, it is intuitive that higher FICO score is associated with lower likelihood of default.

1. ***Document the process for considering, transforming, and making final selection of variables/parameterization (Standards 21, 22, 23, and 24)***

This section should document the variable selection process, from candidate variables considered to final variables selected, including:

* Candidate variables considered and evidence of engagement of stakeholders: For example, “based on engagement with stakeholders, ten candidate variables are selected and descriptions are provided as below” is one way to provide transparency in documentation.
* Parameterization method to select variables; For example, “t-tests are conducted to assess statistical significance of candidate variables. Table below shows selected variables with t-test result. Business stakeholders are engaged to sign-off on intuitiveness of the variables” is one way to provide transparency in documentation.
* Final selection of the variables. What is the final modeling equation?

For vendor models, this information may be proprietary. If vendor proprietary information is unobtainable, document this as a limitation.

1. **Testing and Final Model Selection**

This section confirms that the model is functioning and performing appropriately, including evaluation by Model Developer, Model Owner and Model Users.

1. 1. **Testing**

The objective of this section is to document model testing results and demonstrate performance.

1. ***Identify tests that collectively ensure the model is functioning as designed, establish preliminary expectation of the testing output and any boundaries of model effectiveness and assess validity of the model, and execution the required tests and assessment of results (Standard 25, 26, and 27)***

This section should document key model testing performed to demonstrate the appropriateness and robustness of the model. For example, how is model testing conducted? What is the acceptable range of the model forecasts/results and error range? How is it aligned with on-going monitoring plan for the model? For example, “backtesting using quarterly data from Jan 2007 to May 2016 is conducted comparing actual default rate with predicted with KS statistics of 0.7 indicates model is robust” is an effective way to document model performance. More details are in 1st LOD model development standard.

For Vendor models, this section should document the evaluation of vendor provided testing results, evidence of applicability of the model on KeyCorp’s portfolio and mitigations to ensure vendor model performance

* 1. **Final Model Selection**

This section documents the vetting and consensus of the final model and its appropriateness from stakeholders.

1. ***Document management overlays or adjustments to raw model output to remediate model limitations, and ensure they are justified and done transparently and systematically, with appropriate review and approval (Standard 29)***

This section should document needed overlays/adjustments and rationales. The process for applying overlays/adjustments should be included with support from stakeholders and be systematically applied to ensure that the model users receive the agreed-upon model output post overlays/adjustments.

1. **Handoff and Ongoing Monitoring Plan** 
   1. **Handoff**

***5.1.1 The final model choice, including data requirements, parameter estimation, and documentation, is developed in such a way to facilitate model handoff, including: (Standard 34)***

* ***Raw datasets and a data dictionary describing the data attributes***
* ***Documented code used to aggregate raw dataset from source systems and transformation of the raw dataset into final development datasets***
* ***Final model development sets (or evidence to support data standards for vendor models)***
* ***Information about the production implementation platform, including upstream and downstream dependencies.***
* ***Once model is implemented, include evidence that the implementation is consistent with the documented model***

This section should demonstrate that:

* 1. Model owner obtains the raw data from source system before any processing, data dictionary describing raw data attributes, and codes used to transform the raw data into an input dataset to run the model.
  2. The platform where the model resides (e.g. Excel, SAS, Linux, QRM, a vendor).
  3. Upstream dependencies and downstream dependency are documented. Examples of upstream dependencies are models required as an input to run the model. Please note the section of this information if this has been articulated in other parts of this template.
  4. Downstream dependencies are models/reports that need the output of this model.
  5. Implementation testing is documented to confirm that the model implemented in production is the same model approved and validated by Model Risk.
  6. **Ongoing Monitoring Plan (Standard 35)**

This section is to document the ongoing monitoring and assessment in order to evaluate performance of the model. For vendor models, this should provide the testing results provided by the vendor as well as the model performance on KeyCorp’s data.

1. ***Document the types of tests that will be performed regularly to ensure model performance is completely assessed; Identify Thresholds escalation procedures***

This section should include:

a. testing performed to demonstrate model performance, for example backtesting, sensitivity testing, override analysis, and benchmarking, when applicable.

b. acceptable model performance criteria and agreed upon triggers (e.g. thresholds or performance bands), and stakeholder actions if a trigger is tripped.

c. the frequency of monitoring: Note that Model Risk Policy requires models to be monitored at least annually.

1. ***Reassess model limitations identified in development state, re-verify internal and external data inputs, and evaluate whether changes in data, products, exposures, activities, clients, or market conditions necessitate an adjustment, redevelopment, or replacement of model***

This section should include assessment during monitoring phase to:

a. Re-assess model limitations identified during model development.

b. Demonstrate adequacy of the mitigation plan during model development to address model limitations.

c. Document change in the internal and external data sources, and market condition, such as underwriting standard, product, exposures, and impact on the model.

1. **Governance and Control Activity**

This section is to provide information on the governance and control in place to ensure the overall soundness of the model production environment.

1. 1. **Governance and Control**

This section is to identify the design and execution of governance and control activities as noted in the steps below. This section should note any complexities or subtleties within the model that warrant additional consideration.

1. ***Model Security to ensure that only authorized individuals can access the model, including frequency of review***

This section should include sufficient detail to attest to the security of the model to ensure that the model and its results are secure from unauthorized personnel or mistaken/erroneous input. It may be advantageous to include the location of the model, its results, and other important documentation (e.g. model documentation, operating procedures, etc.). Model Security may be assessed through a regular review of individuals with access to the model, password protection with a procedure to continually update the password on defined intervals, having read-only access for a model in production, or other ways.

1. ***Change Management to provide sufficient corporate memory, business interpretation, and to ensure unapproved changes do not occur***

This section should document the details of the change management processes related to the model. For example, how changes are made to the model, how they are tracked and monitored, and how to prevent inadvertently or intentionally changing the model or modeling process. Additionally, change management should provide sufficient corporate memory to understand the progression of the model and to assist in business interpretation of the modeling results. A common change management process is a change log, which tracks changes and includes information such as change details, impact assessment, individuals making the change with date, individual testing the change with testing results, approval of the change with date, and date of implementation.

1. ***Model Version control to ensure that the approved model is used in production***

This section should detail the actions taken to ensure that the model used in production is the approved model and that it is executed consistently and appropriately. This could be confirmed through a version control on the model and documentation (e.g. version 1.3) or a date of execution. If the model is automated, the code may ensure that the appropriate version of the model is used and could be included as evidence.

1. ***Model Governance/Oversight – detailing Committees or Working Groups that review the model and/or its results, including frequency of meetings***

This section should detail the oversight activity that ensures the model is used in an appropriate manner with realistic results. The model material/information/results should be presented to Committees, Working Groups responsible for oversight of the model, or Line of Business user meetings, as applicable, regularly and in an interpretable manner. Include with justification the frequency of this oversight, information that is to be escalated (e.g. performance monitoring, model changes, findings, etc.), and the members of this group.

1. ***Policies and Procedures that detail how to operate and/or maintain the model***

This section should document policies and/or procedures, as applicable, created to consistently and accurately operate and maintain the model.

1. ***Vendor Management including ongoing discussion with the vendor and a contingency plan in the event that the vendor becomes unavailable***

This section is only necessary for modeling processes that rely on vendors or third parties to execute or maintain the model. For models that rely on vendors, include information on the frequency and content of discussions with the vendor to ensure that the vendor products continue to be appropriate and functional for KeyBank purposes. Additionally, include the Contingency Plan for the model which formally details actions that will be taken by Management in the event that the vendor is unavailable for use. The plan should specifically cite alternative processes (e.g. the specific platform where the model could be moved internally or a specific vendor that could provide KeyBank with the services required). Consider time and costs associated with the transition strategy. In many cases there are short-term and long-term components to Contingency Plans, please document both as applicable.

1. ***Any additional applicable information***

This section is to include any other applicable information that may ensure the ongoing appropriateness of the model..

1. **References**

Please include applicable references or related documents below, such as operating procedures, contingency plans, etc.