



Model Risk Management

WE ARE A LEADING PROVIDER OF SOFTWARE SOLUTIONS AND CONSULTING SERVICES IN THE RISK, WEALTH AND ASSET MANAGEMENT SPACE

Prometeia is a global firm of quantitative experts and software engineers, dedicated to applying financial modelling, economic research and data science to solve complex business and regulatory challenges. Founded in 1974 as an independent institute for economic research by a group of young university professors, for half a century Prometeia has been developing innovative software solutions, studies, and reports for banking and insurance groups, institutional investors and public

organizations. Our mission is to combine academic excellence with industry experience, integrating macro-economic research, quantitative analysis, business consulting and software development. This distinctive mix of competences has made Prometeia a leading European company in risk, asset and wealth management solutions. Prometeia's technology and specialized advisory are chosen by 300 customers in over 20 countries around the world.

OUR COMBINATION OF RISKTECH PROPOSITION, QUANTITATIVE ADVISORY, AND FINANCIAL AND ECONOMIC RESEARCH MAKES OUR BUSINESS MODEL UNPARALLELED IN TODAY'S MARKET

Prometeia's approach to Enterprise Risk Management is based on the development of quantitative models and advanced analytics. The design of highly specialized software solutions combines cutting-edge technologies and data science techniques with the knowledge of our subject mat-

ter experts and our ability to successfully respond to the growing demands of international regulation. Our deep understanding of financial markets, derived from proprietary economic research, adds a unique element to Prometeia's business model and value proposition.

OUR FLAGSHIP MODEL MANAGEMENT SUITE

Models are a strategic component into the decision-making process. It is crucial to manage their entire lifecycle (from design to final implementation) to reach the target standards in performance and reliability. Model Risk Man-

agement (MRM) is a comprehensive framework where all the steps in the model's lifecycle are properly defined, allocated to specific owners, monitored, documented, and traced for future regulatory checks.

Risk Management practitioners are aware that MRM implies a relevant complexity due to:

Proliferation of models (regulatory and managerial)	Proliferation of stakeholders with different prerogatives involved in different tasks (design, development, approval, implementation, validation, monitoring, model change, dismissal)
Models running in parallel at different stages of their lifecycle, requiring different actions with cross connections among them	Regulatory push towards a Model Management Framework to minimize model risk and to reduce capital add-ons and Margins of Conservatism (MOC)

For example, dozens of models in the credit risk space should be included in the MRM framework:

PD models split by segment/product, both acceptance and behavioral	LGD models split by segment/product, both performing and in default
EAD models split by segment/product	Managerial models as Delegation of power, Early warning, Pricing split by risk segment
Accounting: IFRS9 calibrations, satellite models, transition matrices	

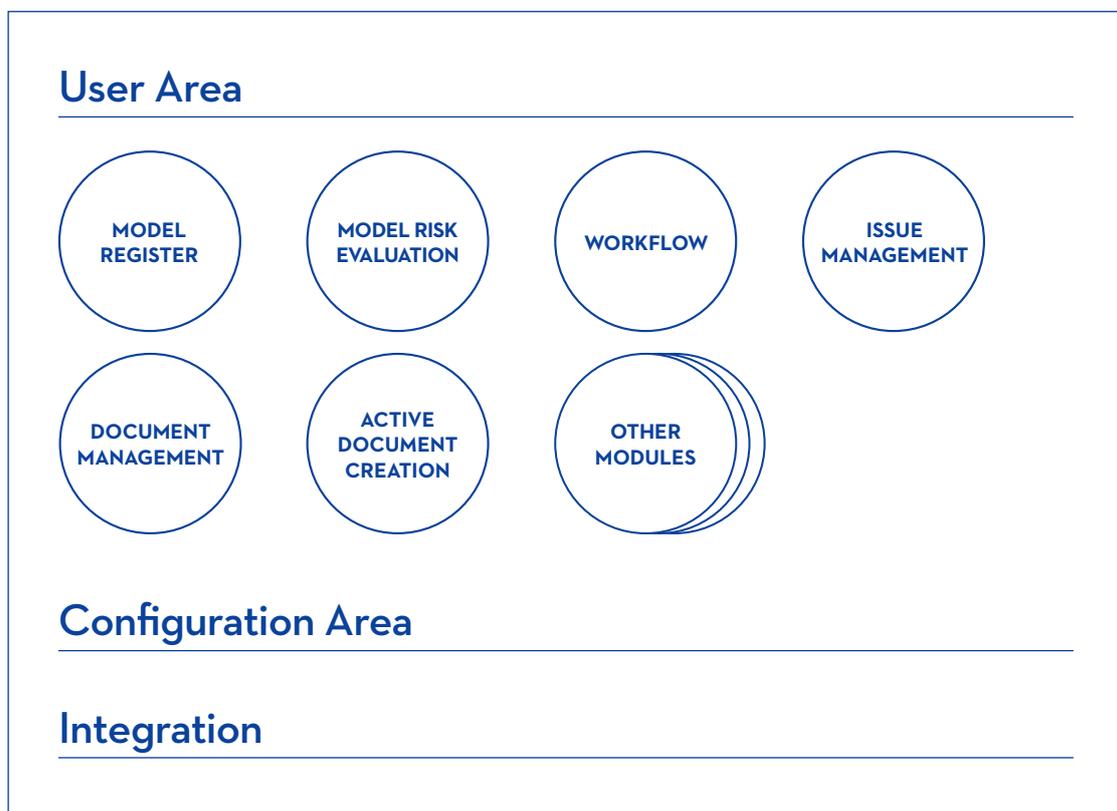
The example can be easily extended to the other risks, dramatically increasing the number of models to be included in the perimeter. Of course, the MRM framework is not only a matter of methodology but includes organization infrastructure, policies and proce-

dures, process design, and IT infrastructure. In our approach, a sound MRM framework must be supported by a specialized software solution that implements a comprehensive set of scalable and modular features.

Model Management modules

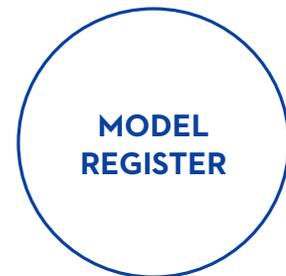
WHY PROMETEIA

Engineered solution coherent to regulatory requirements	Part of a more comprehensive and scalable platform for model implementation/ validation
Turnkey project	End to end support (from design to implementation)
Unique methodological track record	Scale in the updating of future regulatory requirements



User Area

Model Register is the module where the model's information is collected and visualized in order to provide each user the relevant set of information to keep track of the model's evolutions and potential areas of intervention. The information is structured according to the user's profile. Users are organized in roles with different prerogatives in the interaction with the system.



The Model Register's main features are:

Models Inventory to collect and publish all model's attributes as status, development date, modifications log, current phase in the model lifecycle, data sources, logical/physical data model

Users profiling for the implementation of roles, prerogatives, access rights, connections with other users

The association among model and users is allocated the different level of responsibilities

Model Map for the association among models to establish the connections and to identify in case of modification in one model, which are the other models that are affected

The list of controls executed and related open issues and remedy actions

Models are listed and organized by priority

Code	Description	Version	Lifecycle phase	Model family
Lifecycle phase : Implementation and Deploy - InProgress				
PD_SME	Probability of Default - SME	V1	Implementation and Deploy - InProgress	Pillar 1 Models
Lifecycle phase : Model Creation - InProgress				
PD_SME	Probability of Default - SME	V2	Model Creation - InProgress	Pillar 1 Models
EL_Large_Corporate	Expected Loss - Large Corporate	V1	Model Creation - InProgress	Pillar 1 Models
LGL_Corporate	Loss Given Loss - Corporate	V1	Model Creation - InProgress	Pillar 1 Models
EAD_SME	Exposure At Default SME	V1	Model Creation - InProgress	Pillar 1 Models
LGD_RRE	Loss Given Default RRE	V2	Model Creation - InProgress	Pillar 1 Models
LGD_RRE	Loss Given Default RRE	V1	Model Creation - InProgress	Pillar 1 Models

Models details are collected according to the model type

Overview > PD_SME > V1 - Sep 14, 2021

Clustering: Monographic Regulatory

Status: List

Development Description: Development of a Statistical PD Model for the calculation of the Risk Weighted Assets within the IRB Approach. The model covers the Small Medium Enterprise segment.

Model family: Pillar 1 Models

Model sub-family: Credit Risk

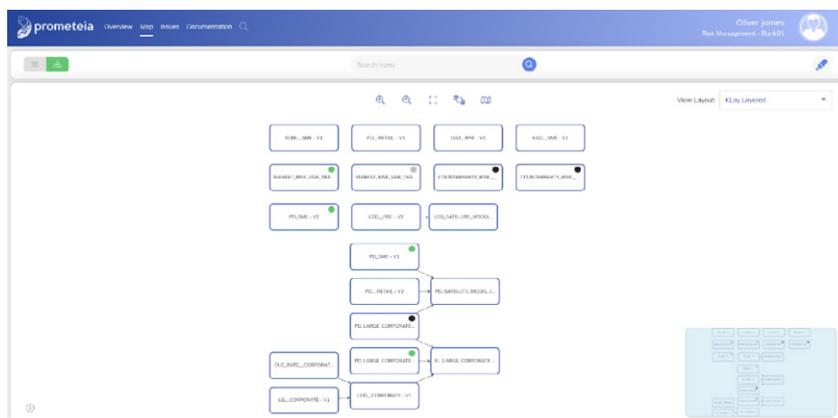
Model sub-family Type: PD

Model Performance: Medium

Model Tier: T1

Materiality: Material

Models are properly mapped including the models' connections



This module allows institutions to implement internal model risk calculation based on quantitative and qualitative data. Possibility to perform validation checks and see validation results, calculate model Tiering, Model Management Index and model Residual Risk.



It is possible to set-up qualitative questionnaires, calculate scorecards and assign specific scores to questions and/or checks

Control Name	Metric	Metric Value	Outcome
December 31 2020 Representative Analysis	PSI	0.5	GREEN
December 31 2020 Performance Analysis	Accuracy Ratio	6000	YELLOW
November 30 2020 Representative Analysis	PSI	8	RED
November 30 2020 Performance Analysis	Accuracy Ratio	6000	GREEN
October 31 2020 Representative Analysis	PSI	7	RED
October 31 2020 Performance Analysis	Accuracy Ratio	6400	YELLOW
September 30 2020 Representative Analysis	PSI	7.1	RED
September 30 2020 Performance Analysis	Accuracy Ratio	6200	YELLOW
August 31 2020 Representative Analysis	PSI	6.5	RED

Methodological approach Explain

The statistical development of the model it is based on a traditional approach. Each sub-modules it is obtained through the following main steps:

1. data preparation
2. feature engineering
3. feature selection - univariate process based on performance metrics and a stepwise selection
4. modeling - logistic regression

Data sources: Internal

Data sources Explain

The main dataset used for the development are internal (balance sheet, customer master data...) but some customer-related variables are retrieved from an external web database

Model Tiering: Tier2

Attachment

- 2019 DoD Documentation.docx (0 Bytes)
- PD SME McColock (307.13 KB)

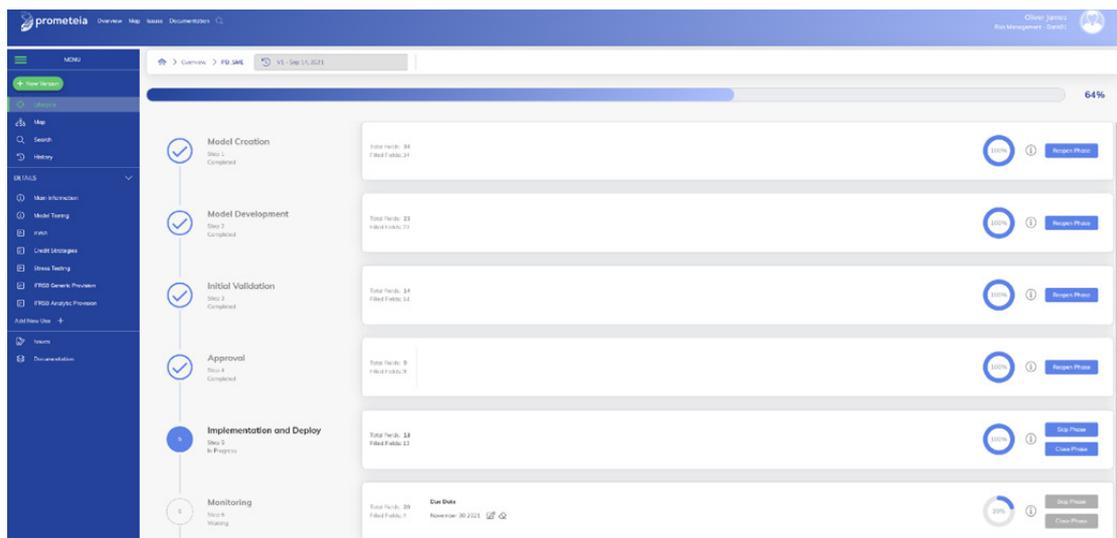
The workflow is the module that implements the set of activities to be executed on the model according to its position in the lifecycle path and its current performance.



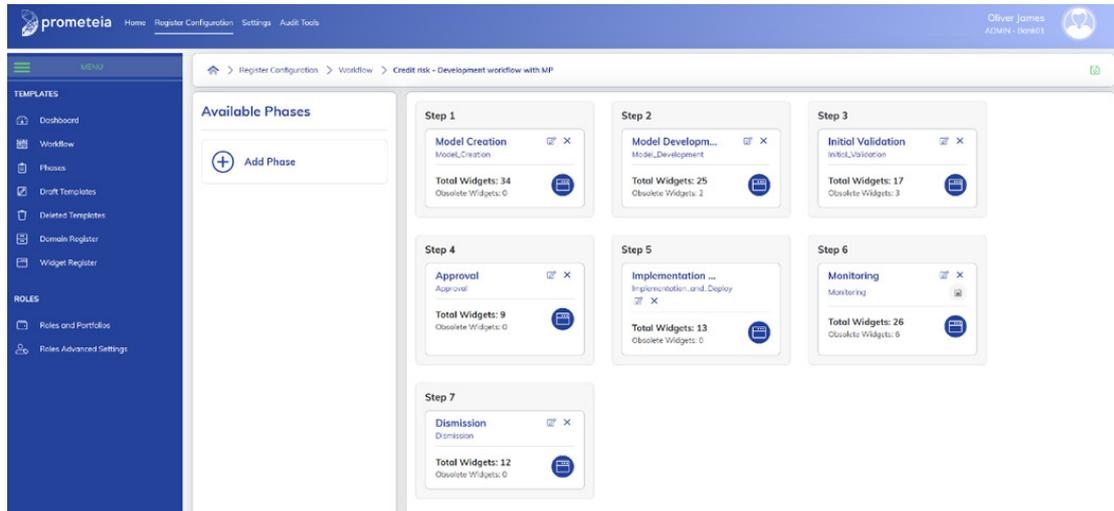
The module is designed to:

<p>Define the appropriate processes via a set of steps to be executed in the sequence per each model</p>	<p>Define the actions to be taken in each step according to the information collected and the controls outputs/severity</p>
<p>Define the expected timeline in the process execution including the support of a scheduler, reminders, alerts, task notifications</p>	<p>Monitor the process' progress (status and owners) and activate overrides and exceptions</p>

The steps are defined and the progress is monitored

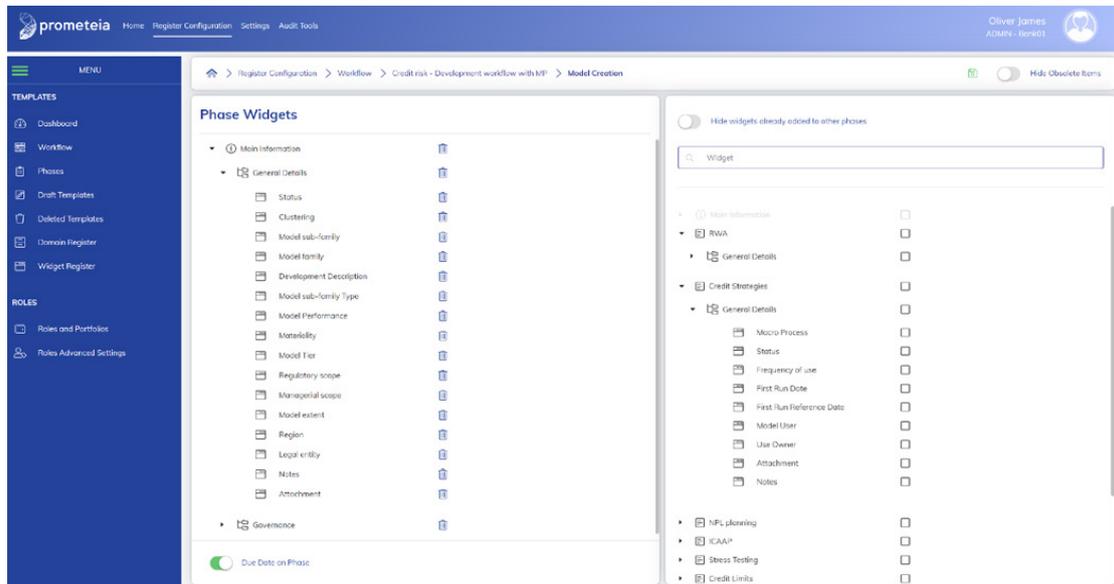


Activities are designed via drag and drop interface



The screenshot shows the Prometeia interface for configuring a workflow. The breadcrumb trail is: Home > Register Configuration > Workflow > Credit risk - Development workflow with MP. The left sidebar contains 'TEMPLATES' (Dashboard, Workflow, Phases, Draft Templates, Deleted Templates, Domain Register, Widget Register) and 'ROLES' (Roles and Portfolios, Roles Advanced Settings). The main area is titled 'Available Phases' and contains an 'Add Phase' button. Below this are seven step cards:

- Step 1: Model Creation** (Model_Creation) - Total Widgets: 34, Obsolete Widgets: 0
- Step 2: Model Developm...** (Model_Development) - Total Widgets: 25, Obsolete Widgets: 2
- Step 3: Initial Validation** (Initial_Validation) - Total Widgets: 17, Obsolete Widgets: 3
- Step 4: Approval** (Approval) - Total Widgets: 9, Obsolete Widgets: 0
- Step 5: Implementation ...** (Implementation_and_Deploy) - Total Widgets: 13, Obsolete Widgets: 0
- Step 6: Monitoring** (Monitoring) - Total Widgets: 26, Obsolete Widgets: 9
- Step 7: Dismissal** (Dismissal) - Total Widgets: 12, Obsolete Widgets: 0



The screenshot shows the 'Phase Widgets' configuration for the 'Model Creation' phase. The breadcrumb trail is: Home > Register Configuration > Workflow > Credit risk - Development workflow with MP > Model Creation. The left sidebar is the same as in the previous screenshot. The main area is titled 'Phase Widgets' and includes a 'Hide Obsolete Items' toggle. A search bar for 'Widget' is present. The widget configuration is shown in a tree view:

- Main Information
 - General Details
 - Status
 - Clustering
 - Model sub-family
 - Model family
 - Development Description
 - Model sub-family Type
 - Model Performance
 - Materiality
 - Model Tier
 - Regulatory scope
 - Managerial scope
 - Model extent
 - Region
 - Legal entity
 - Notes
 - Attachment
 - Governance

At the bottom, there is a 'Due Date on Phase' toggle. On the right, a list of widgets is shown with checkboxes:

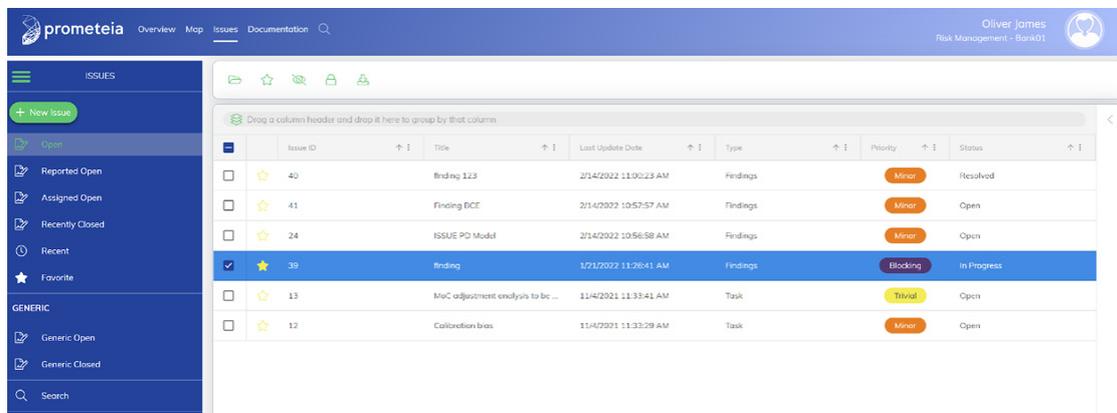
- Main Information
- ROAA
- General Details
- Credit Strategies
- General Details
 - Micro Process
 - Status
 - Frequency of use
 - First Run Date
 - First Run Reference Date
 - Model User
 - User Owner
 - Attachment
 - Notes
- NPL downing
- YAAP
- Stress Testing
- Credit Limits

Issue and findings module allows the users to manage any kind of activity that can be generic or connected to specific items/models.



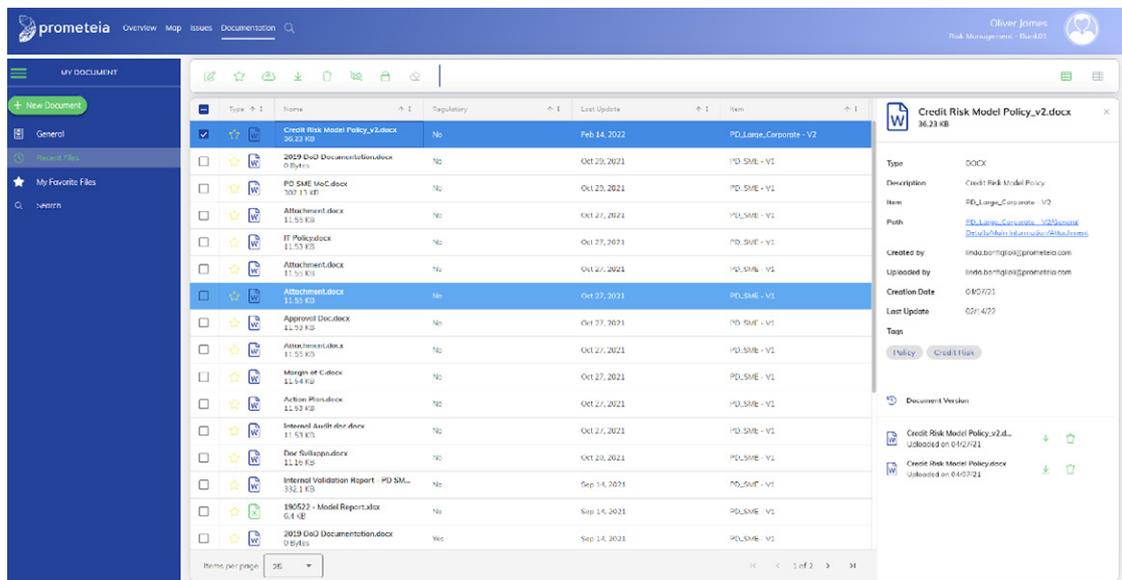
Option to indicate and visualize:

History and track of modifications	Status
Priority	Assignee
Due date	Resolution status and date



Issue ID	Title	Last Update Date	Type	Priority	Status
40	finding 123	2/14/2022 11:00:23 AM	Findings	Minor	Resolved
41	Finding DCE	2/14/2022 10:57:57 AM	Findings	Minor	Open
24	ISSUE PD Model	2/14/2022 10:56:58 AM	Findings	Minor	Open
39	finding	1/21/2022 11:26:41 AM	Findings	Blocking	In Progress
13	MoC adjustment analysis to be ...	11/4/2021 11:33:41 AM	Task	Trivial	Open
12	Calibration bias	11/4/2021 11:33:29 AM	Task	Minor	Open

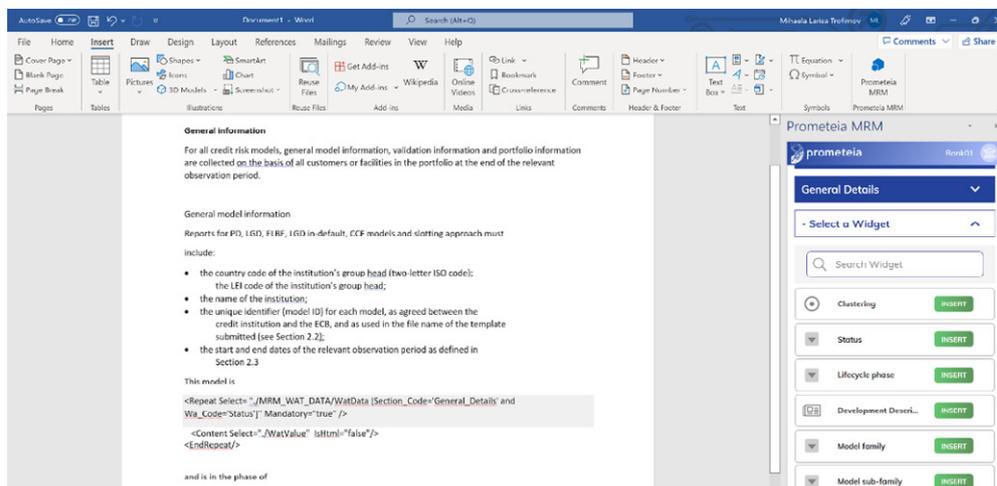
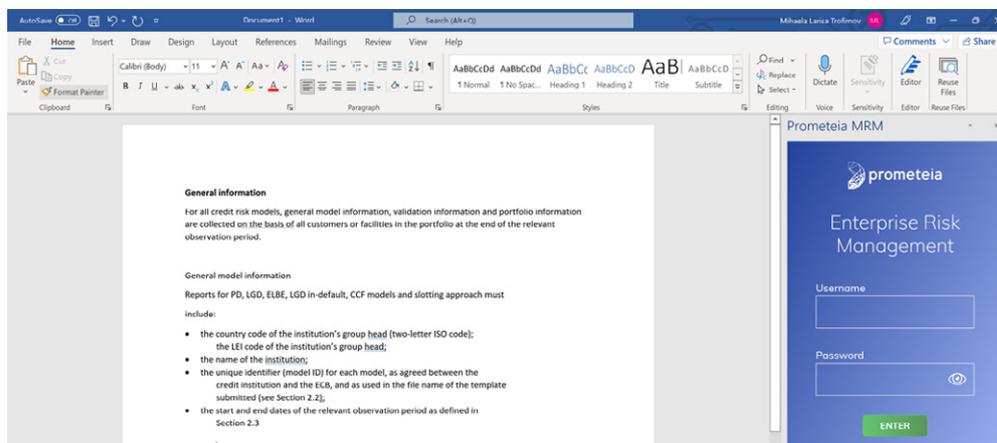
The Document Management feature is designed to collect and manage external documents in any format (documents upload/download and tagging) that can be linked to the single model or cross models. The documents can be stored in a general container (as general documentation) or linked to the specific items, and the user can keep track of the version uploaded.



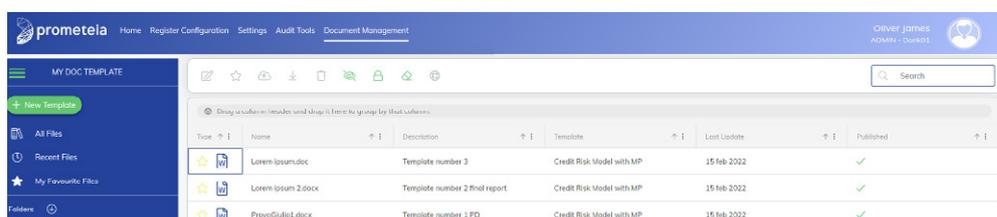
Create via user friendly interface, directly connected to the application, MS Word templates that will be automatically filled by the system (such as model reports, tables, etc.).

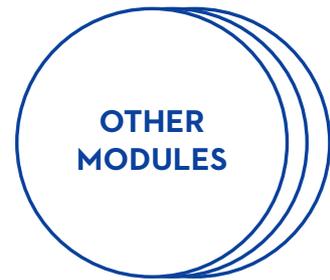


Users can indicate the fields to be retrieved in the document by simply clicking without the need of writing any code (that is written automatically)



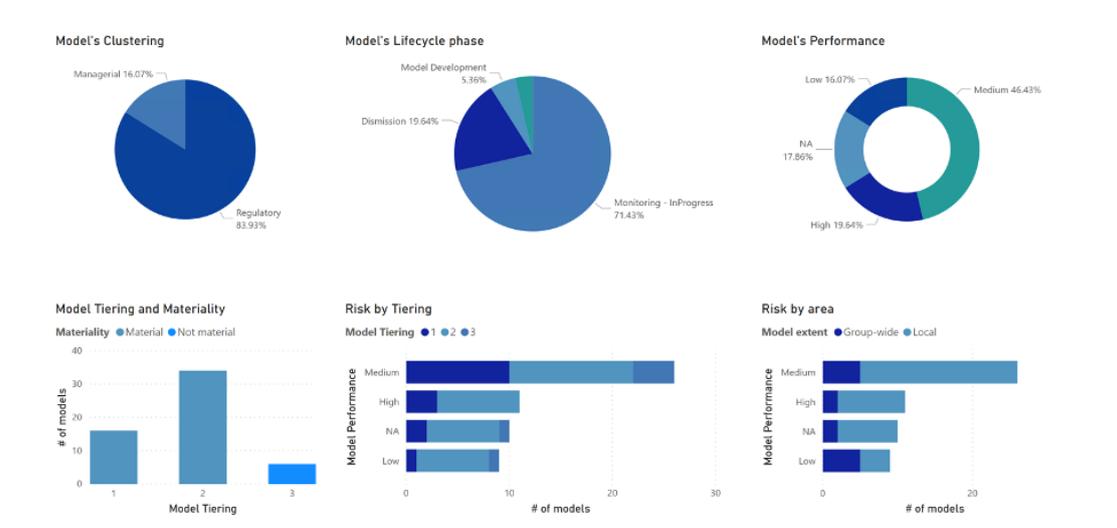
Documentation module in Admin mode in order to upload the predefined MS Word template





The Dashboard implements reports on:

Controls' outputs (aggregated and drill-downs)	Matrix model's expected status vs current status
Heat maps	Model Performance trends



E-mail notifications inform the users during the process of any changes or issues to the models, as well as informing on the coming due date of the model lifecycle's phases.

The application manages:

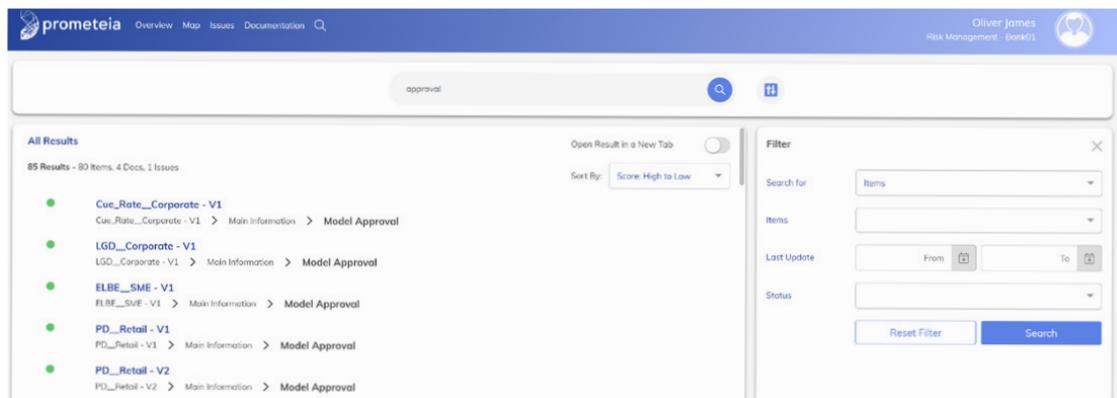
Integration with internal/external data sources

Data quality/manipulation/storing

Replicability

Warning in data quality (missing fields, inconsistencies, etc.)

Collection and the tagging of annexed documents



Configuration Area

Configuration is the area where the super user, i.e. administrator and/or advanced users, can set all the main configuration related to User area; platform provides with easy and integrated tools design and the level of structuring of the solution adapts to the organizational context, to the number and variety of models involved. No-Code solution to quickly intercept further change needs.

The Configuration Area's main features are:

Template Configuration area

is designed to:

- Fully customize the inventory via drag-and-drop tools that enable to develop template structure quickly without coding;
- Configure thresholds for status definitions, KPIs, and metric scorecards;
- Update Management feature.

Workflow Configuration area

is designed to:

- Fully customize the workflow for each template structure via drag-and-drop tools that enable to develop workflow and phases structure quickly without coding.

Roles and legal entities area

is designed to:

- Define a multi-dimensional structure to support groups vs. stand-alone institutions;
- Setting roles, grants and visibility to share working area information within the same office or in other departments.

Settings:

- **E-mail Settings:** E-mail notifications allow to inform users during the process of any changes or issues to the models, as well as informing on the coming due date of the model lifecycle's phases;
- **Language Settings:** Multi-language settings.

Audit Tools: allow the user to export by easily filter tracking of data changes.

Integration

The platform is able to integrate with other systems, engage with data from different sources and integrate with third-party systems.

The main features are:

Access: Build-in Form Base Authentication. Integration with Windows Active Directory, Azure Active Directory, SAML2, legacy identity provider;

API's & Connectors to integrate with other systems

Export data:

- Simplified Data Export by CSV of register area, workflow process information and issues;
- Integration with third-party software for external reporting tools;

DMS: Connection with third-party document management system;

Integration with laboratory environment and validation controls;

Add-in: MS Document automation with MS Word add-in.



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