SAS® FORUM
PORTUGAL 2016

Bem Vindos

MODEL RISK MANAGEMENT

Carles Cerdà

Risk & Finance

Business Solutions Manager

Copyright © 2015, SAS Institute Inc. All rights reserved.

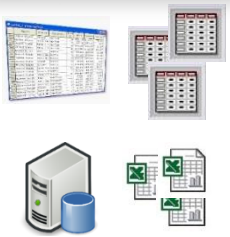
MODEL RISK MANAGEMENT

WHAT IS A MODEL?

SAS® FÓRUM PORTUGAL 2016

Qualitative

Quantitative



Input

Mathematical

Statistical

Economic

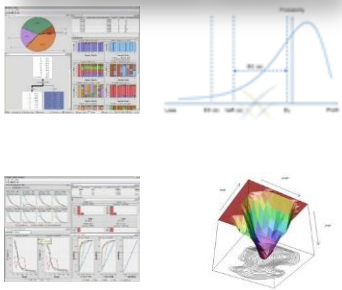
Processing

Decision Support

Business Analysis

Risk Management

Balance-Sheet Stress-test



Estimates

Copyright © 2013, SAS Institute Inc. All rights reserved.

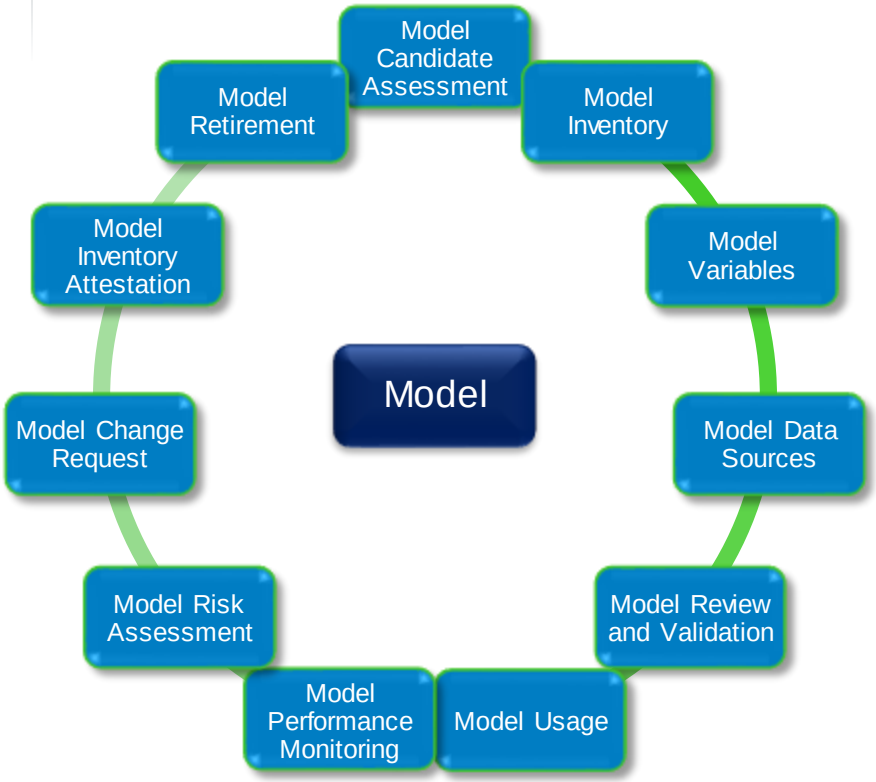
sas THE POWER TO KNOW.

MODEL RISK MANAGEMENT

MODEL'S LIFECYCLE

Support Functions

- MRM Correspondence
- Policy Management
- MRM Dashboard
- Findings
- Action Plans



Administrative Functions

- Workflow Management
- Document Management
- Data Management
- User and Role Management
- Other System Administration

Copyright © 2013, SAS Institute Inc. All rights reserved.

MODEL RISK MANAGEMENT

MODEL RISK DEFINITION

Decision Support Models

Model is fundamentally wrong

Model is misused or misapplied

Solvency, Liquidity, Capital Adequacy

Copyright © 2013, SAS Institute Inc. All rights reserved.

MODEL RISK MANAGEMENT

MEETING REGULATORY GUIDELINES GLOBALLY

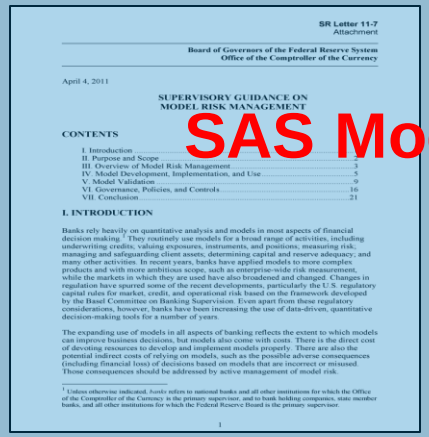
SAS® FÓRUM PORTUGAL 2016

- Model risk management Regulation tightened first in US
- EMEA is now following

Federal Reserve SR11/7 (Apr 2011)

EBA SREP Guidelines (Dec 2014)

Local Regulator Implementation (Jan 2016)



SR Letter 11-7
Attachment

Board of Governors of the Federal Reserve System
Office of the Comptroller of the Currency

April 4, 2011

SUPERVISORY GUIDANCE ON MODEL RISK MANAGEMENT

CONTENTS

I. Introduction 1
II. Purpose and Scope 2
III. Overview of Model Risk Management 3
IV. Model Development, Implementation, and Use 5
V. Model Validation 9
VI. Governance, Policies, and Controls 16
VII. Conclusion 21

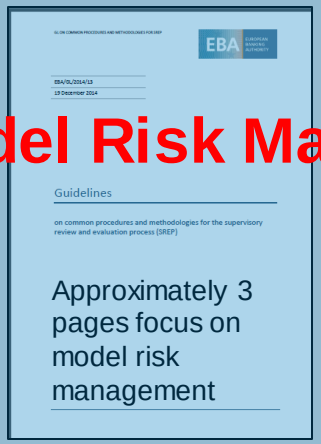
I. INTRODUCTION

Banks rely heavily on quantitative analysis and models in most aspects of financial decision making.[1] They routinely use models for a broad range of activities, including underwriting credits, valuing exposures, instruments, and positions; measuring risk; managing and safeguarding client assets; determining capital and reserve adequacy; and many other activities. In recent years, banks have applied models to more complex products and with more ambitious scope, such as enterprise-wide risk measurement, while the markets in which they are used have also broadened and changed. Changes in regulation have spurred some of the recent developments, particularly the U.S. regulatory capital rules for market, credit, and operational risk based on the framework developed by the Basel Committee on Banking Supervision. Even apart from these regulatory considerations, however, banks have been increasing the use of data-driven, quantitative decision-making tools for a number of years.

The expanding use of models in all aspects of banking reflects the extent to which models can improve business decisions, but models also come with costs. There is the direct cost of devoting resources to develop and implement models properly. There are also the potential indirect costs of relying on models, such as the possible adverse consequences (including financial loss) of decisions based on models that are incorrect or misused. Those consequences should be addressed by active management of model risk.

[1] Unless otherwise indicated, *banks* refers to national banks and all other institutions for which the Office of the Comptroller of the Currency is the primary supervisor, and to bank holding companies, state member banks, and all other institutions for which the Federal Reserve Board is the primary supervisor.

1



EBA

EBA/GL/2014/13
19 December 2014

Guidelines

on common procedures and methodologies for the supervisory review and evaluation process (SREP)

Approximately 3 pages focus on model risk management

BaFin

FCA
FINANCIAL CONDUCT AUTHORITY

BANK OF ENGLAND
PRUDENTIAL REGULATION AUTHORITY

SAS Model Risk Management

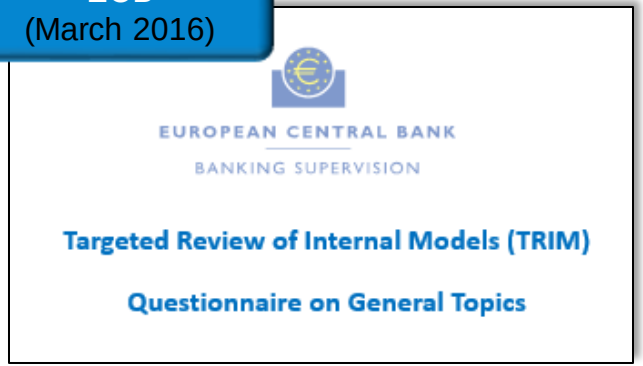
Copyright © 2013, SAS Institute Inc. All rights reserved.

MODEL RISK MANAGEMENT

MEETING REGULATORY GUIDELINES GLOBALLY

SAS® FÓRUM PORTUGAL 2016

ECB
(March 2016)



Instructions for the completion of the questionnaire

Please find below some guidance for providing information on the Questionnaire for General Topics, as part of the Targeted Review of Internal Models (TRIM).

Please read it carefully before starting to fill in the information fields of the excel file.

1. Structure of the questionnaire

The questionnaire is composed of a set of *tabs*, as specified below:

- "Institution identification", initial *tab*, to be filled with the details of the institution and the contact of the person responsible for the questionnaire;
- "Contents" *tab*;
- *Tabs* referring to the general model topics in the scope of the questionnaire:
  - Topic 0: Overarching principles
  - Topic 1: Roll-out and PPU
  - Topic 2: Internal Governance, Internal Reporting and Organisation of CRCU
  - Topic 3: Internal Audit
  - Topic 4: Internal Validation
  - Topic 5: Models Use
  - Topic 6: Management of Models Changes and Extensions
  - Topic 7: Data Quality Management
  - Topic 8: Third party involvement
  - Topic 9: Assignment of Exposures to Exposure Classes
  - Topic 10: Default definition
- One additional *tab*, "Topic 1 – Annex", containing a table to complement the information on Topic 1.

Copyright © 2013, SAS Institute Inc. All rights reserved.

MODEL RISK MANAGEMENT

ORGANIZATION STRUCTURE

SAS® FÓRUM PORTUGAL 2016

= Process area

= Functional team

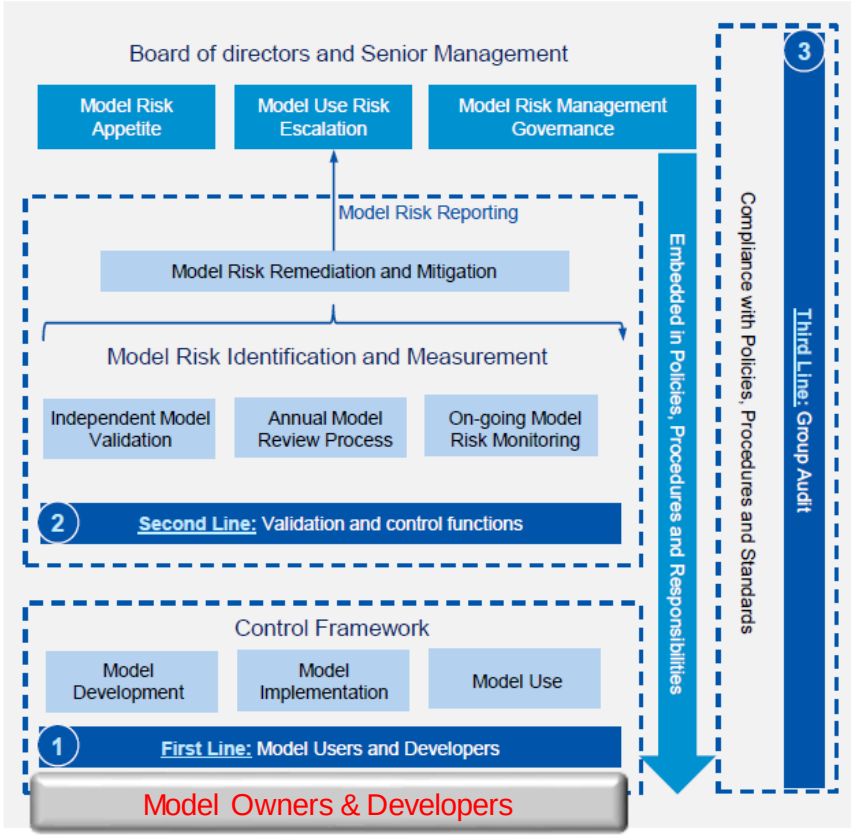
Risk Senior Executives

Model Risk Management

Governance & Control

Model Reviewers & Validators

Operational Model Lifecycle



Independent (periodic) Audit

Internal Audit

Source: Bank Risk Conference presentation in April 2015 by Konstantina Armata (Head of Global Model Validation & Governance at Deutsche Bank)

Copyright © 2013, SAS Institute Inc. All rights reserved.

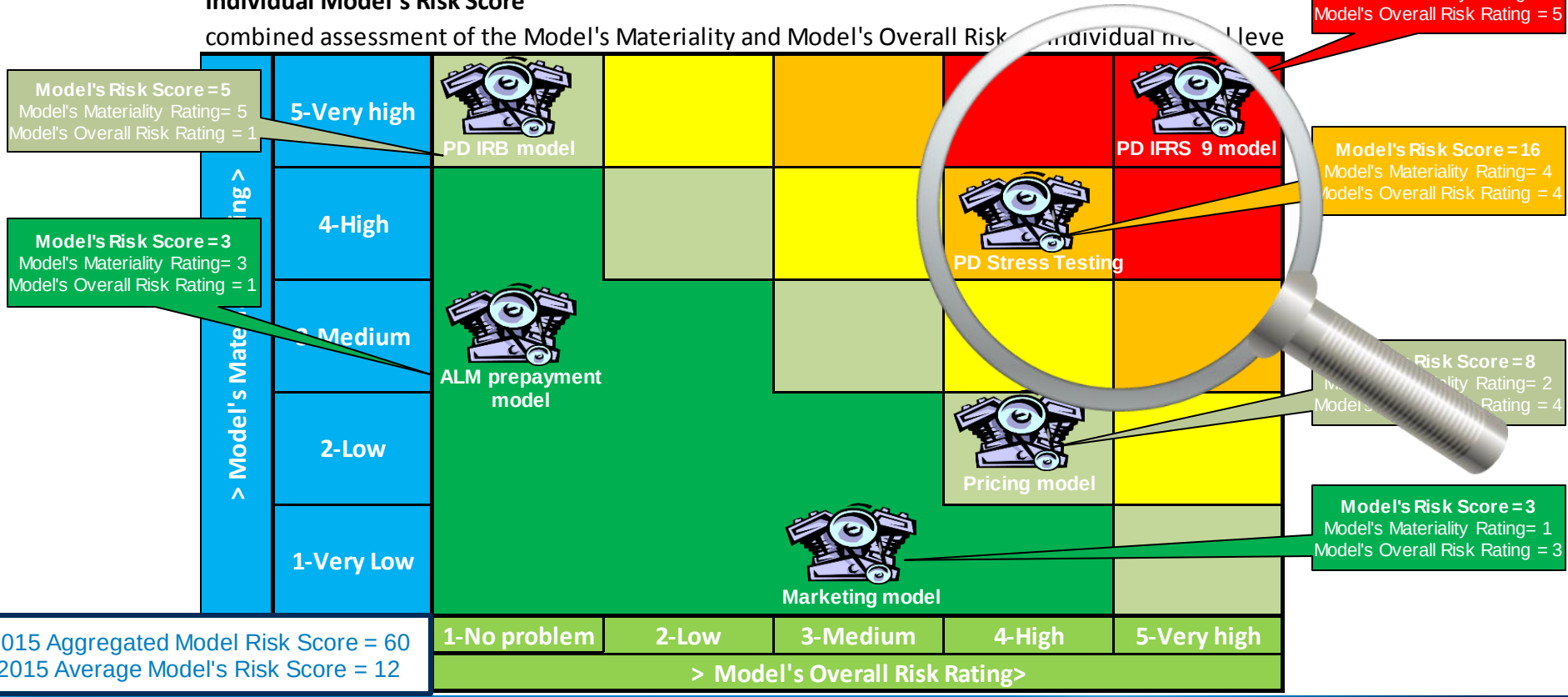
MODEL RISK MANAGEMENT

MEASURING MODEL RISK

SAS® FÓRUM PORTUGAL 2016

Individual Model's Risk Score

combined assessment of the Model's Materiality and Model's Overall Risk ... individual m... leve...



2015 Aggregated Model Risk Score = 60
2015 Average Model's Risk Score = 12

Copyright © 2013, SAS Institute Inc. All rights reserved.

SAS MODEL RISK MANAGEMENT

DISCOVER SUCCESS STORY

SAS® FÓRUM PORTUGAL 2016

Customer Story

We want to build a sustainable and scalable solution for managing models at Discover. The new SAS® system will help us reduce model risk and increase business value.

Abhinav Anand, Chief Model Risk Officer, Discover Financial Services

Industry
Banking

Business Issue
Manage model risk by managing model information.

- 680+ models; 300 usages/applications created
- 1000+ findings & 1000+ action plans back loaded
- Cataloged 12,000+ linked instances to establish a chain of dependency among model, validation, users, and roles.
- Established a 360° link between model, usage, stakeholders, validation, issues and action plans for model lifecycle management.

Solution
SAS® Model Risk Management

Benefit
- Decreases time spent managing models.
- Utilizes analytical staff more effectively.
- Encourages model reuse.
- Makes it easier to meet regulatory requirements such as CCAR.
- Ensures the institution's model risk management program is audit-ready.

Copyright © 2013, SAS Institute Inc. All rights reserved.

MRM DASHBOARD | SUMMARY DASHBOARD

SAS® FÓRUM PORTUGAL 2016

MRM Dashboard - Risk Tier Dashboard

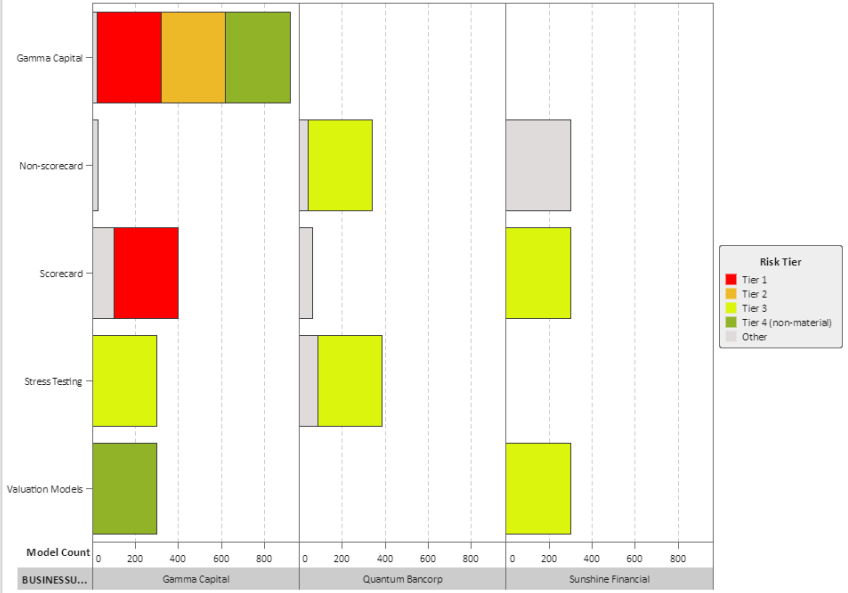
Filter by Business Unit: BUSINESSUNIT Level 1 | BUSINESSUNIT Level 2 | BUSINESSUNIT Level 3

Filter by Model Family: MODELFAMILY Level 1 | MODELFAMILY Level 2 | MODELFAMILY Level 3

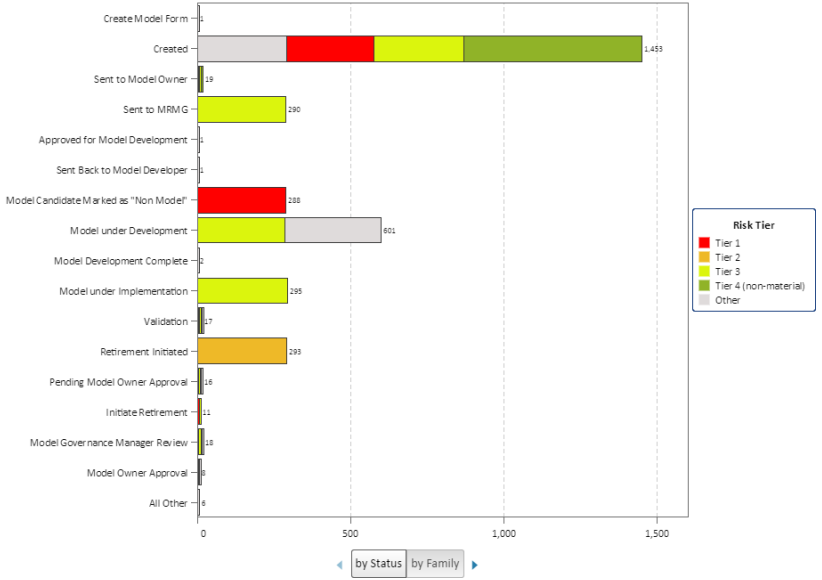
Filter by Model Notation: MODELNOTATION Level

Model Count	Models Used Prior to Validation Count	Finding Count	Action Plan Count	Model Review Count
3,334	1,627	51	0	2

Model Risk Tier by Business Unit and Model Family



Model Risk Tier by Status



Copyright © 2013, SAS Institute Inc. All rights reserved.

MRM DASHBOARD | MODEL INVENTORY

Filter by Business Unit: BUSINESSUNIT Level 1 | BUSINESSUNIT Level 2 | BUSINESSUNIT Level 3

Filter by Model Family: MODELFAMILY Level 1 | MODELFAMILY Level 2 | MODELFAMILY Level 3

Filter by Model Notation: MODELNOTATION Level

Model Owner	Model Count
Reid Hoffman	8

Owner | Developer | User

BUSINESSUNIT Level	Model Id	Model Name	Model Status	Inherent Risk	Residual Risk	Criticality Rating	Finding Count	Model Change Request Count	Model to be used before validation	Model Age in Days	Is Model Development Documentation Attached	Last Model Annual Review Date	Last Va
Bank	10396	test workflow 3	Model under Development	Low	Medium Residual Risk	Fit for Intended Use, with Conditions	0	0	N	.	Y	.	.
Bank	10397	test workflow 4	Model under Development	Low	Medium Residual Risk	Fit for Intended Use, with Conditions	0	0	N	.	Y	.	.
Bank	10398	workflow 5	Model under Development	Low	Medium Residual Risk	Fit for Intended Use, with Conditions	0	0	N	.	Y	.	.
Bank	02_GPF	Group Project Finance	Monitoring and Maintenance	High	Medium Residual Risk	Not Yet Rated	0	1	N	.	Y	.	.
Bank	10389	Group Project Finance	Monitoring and Maintenance	Medium	Medium Residual Risk	Fit for Intended Use, with Conditions	1	0	N	.	Y	.	.
Bank	10417	Final_test_Risb_models	Monitoring and Maintenance	Low	High Residual Risk	Fit for Intended Use	2	2	N	.	Y	.	.
Bank	01_RISB	RISB	Monitoring and Maintenance	High	Medium Residual Risk	Fit for Intended Use	4	4	N	1,545	Y	.	.

Copyright © 2013, SAS Institute Inc. All rights reserved.

MRM DASHBOARD | MODEL DETAILS

Model Summary

Model Id	Model Name	Model Criticality	Model Materiality	Frequency of Model Usage & Other Details	Model Status	MODELFAMILY Level	Parent Model Id	Model_
01_RISB	RISB	Moderate	High		Monitoring and Maintenance	A-IRB	01_RISB	1024

Findings

Finding Id	Finding Description	Status	Severity Tier	Date Created	Recommended/Resolution	Linke Globa
F_10058	Quarterly Data Monitoring Finding	Open	Medium	19Jul2016		1024
F_10059	Step 5 - GIV Q Performance Monitoring Finding via GIV	Open	High	18Jul2016		1024
F_10060	Step 6 RISB Annual Review Finding via GIV	Open	Critical	19Jul2016		1024
F_10069	fsfs	Open	High	20Jul2016		1024

Action Plan Details

Action Plan Id	Action Plan Desc	Priority	Status	Date Created	Linked Model Global Key
A_10006	Quarterly Data Monitoring Action Plan	Medium	Open	19Jul2016	10241
A_10007	Step 5 RISB Q Performance Monitoring	High	Open	19Jul2016	10241
A_10008	Step 6 RISB Action Plan via GIV	Medium	Open	19Jul2016	10241

Model Change Requests

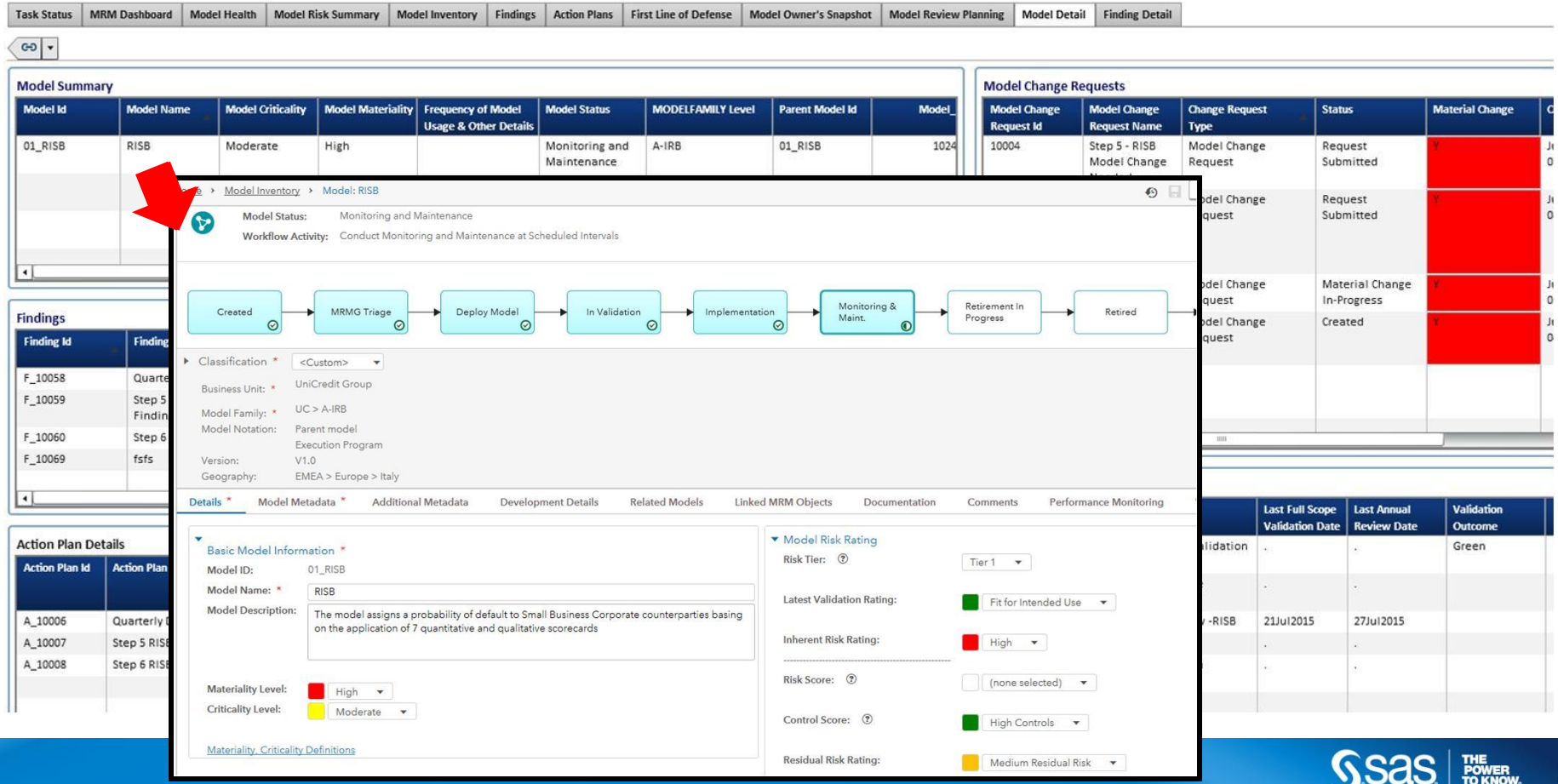
Model Change Request Id	Model Change Request Name	Change Request Type	Status	Material Change	C
10004	Step 5 - RISB Model Change Needed	Model Change Request	Request Submitted	Y	Ju 0
10005	Step 6 RISB Annual Validation Model Change Needed	Model Change Request	Request Submitted	Y	Ju 0
10048	Step 3 Change Request RISB	Model Change Request	Material Change In-Progress	Y	Ju 0
10003	Step 4 RISB Model Change Needed	Model Change Request	Created	Y	Ju 0

Model Review/Validation Details

Model Review Id	Model Review Name	Last Full Scope Validation Date	Last Annual Review Date	Validation Outcome
10111	Step 3 Initial/First Validation RISB	.	.	Green
10117	Step 5 Q Performance Monitoring RISB	.	.	
10121	Step 6 Annual Review -RISB	21Jul2015	27Jul2015	
10124	Step 7 Audit - RISB	.	.	
10132	Step 4 Quarterly Data Monitoring RISB	.	.	

Copyright © 2013, SAS Institute Inc. All rights reserved.

MRM DASHBOARD | MODEL DETAILS



Copyright © 2013, SAS Institute Inc. All rights reserved.

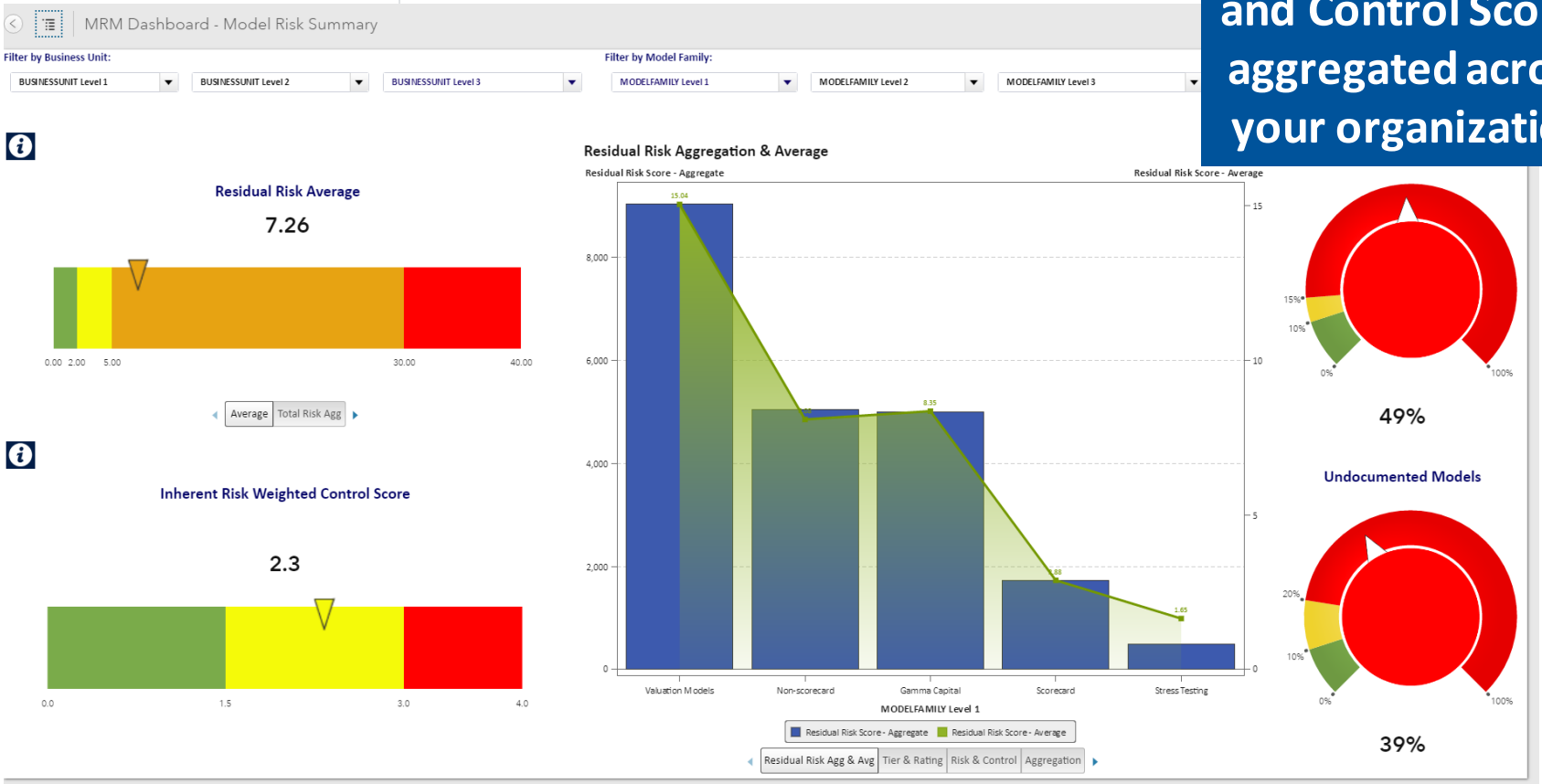
MRM DASHBOARD | DRILL DOWN CAPABILITY

- *Ability to drill from the top down into the information relevant to you.*

Copyright © 2013, SAS Institute Inc. All rights reserved.

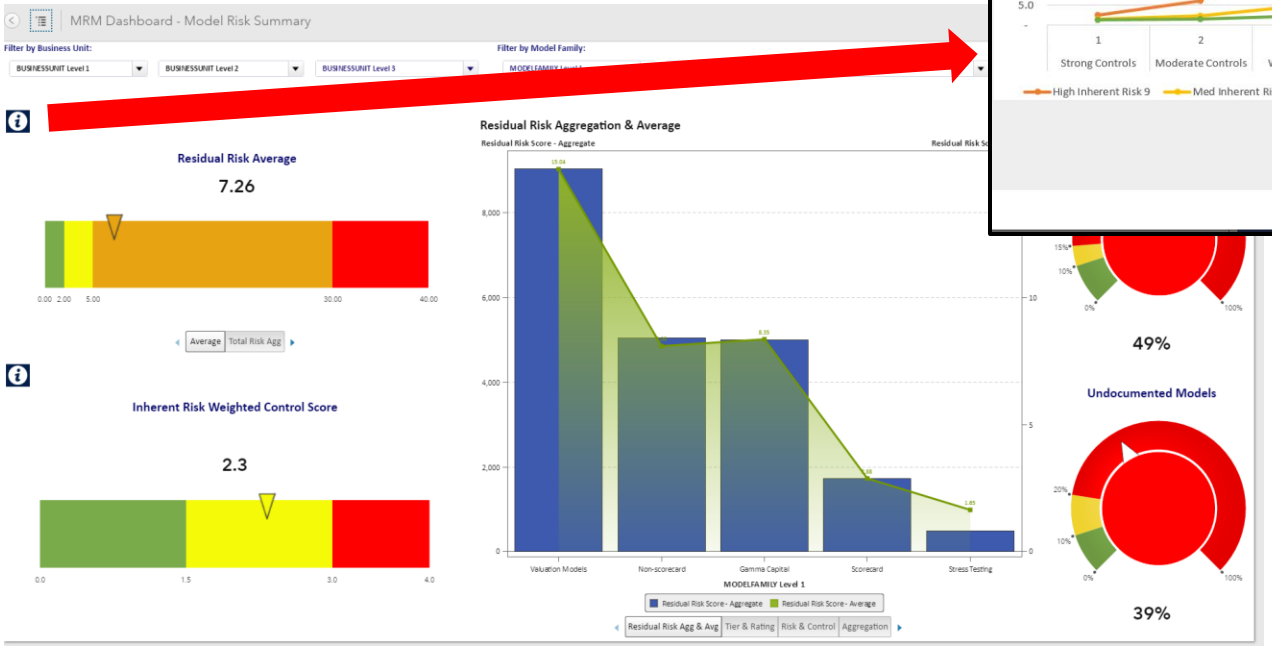
MRM DASHBOARD | MODEL RISK

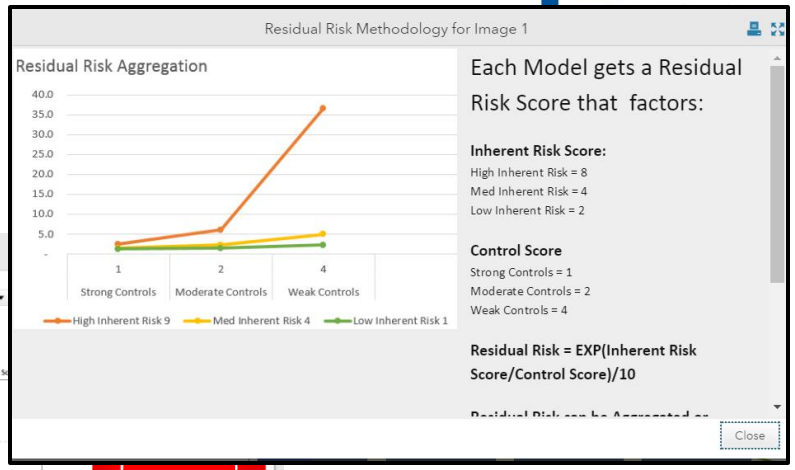
Model Risk Scores and Control Scores aggregated across your organization



Copyright © 2013, SAS Institute Inc. All rights reserved.

MRM DASHBOARD | MODEL RISK





Aggregation methodology flexible to meet your policy.

Copyright © 2013, SAS Institute Inc. All rights reserved.

MRM DASHBOARD

MODEL RISK – ACTION PLANS

SAS® FÓRUM PORTUGAL 2016

Task Status | MRM Dashboard | Model Health | Model Risk Summary | Model Inventory | Findings | **Action Plans** | First Line of Defense | Model Owner's Snapshot | Model Review Planning | Model Detail | Finding Detail

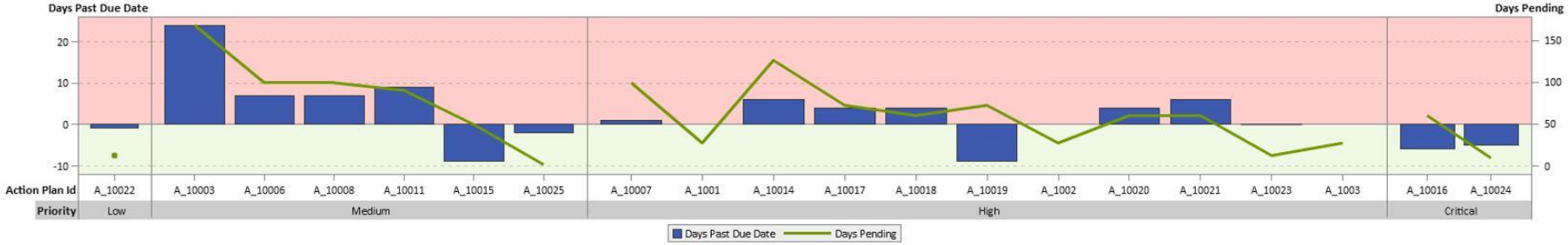
Filter by Business Unit:

BUSINESSUNIT Level 1 | BUSINESSUNIT Level 2 | BUSINESSUNIT Level 3

Filter by Model Family:

MODELFAMILY Level 1 | MODELFAMILY Level 2 | MODELFAMILY Level 3

Action Plan Schedule



When Due	Action Plan Count
Due this month	3
Due this week	4
Late	10
Other	3

Due | Owner | Approver

Action Plans

Action Plan Id	Action Plan Name	Action Plan Desc	Status	Date Created	Original Due Date	Due Date	Action Plan Closed Date	Action Plan Completion Date	Days Pending	Days Past Due Date	Finding Count
A_10006	Step 4 Action Plan	Quarterly Data Monitoring Action Plan	Open	19Jul2016	21Jul2016	21Jul2016	.	.	99	7	0
A_10007	Step 5 RISB Q Performance Monitoring	Step 5 RISB Q Performance Monitoring	Open	19Jul2016	27Jul2016	27Jul2016	.	.	99	1	1
A_10008	Step 6 RISB Action Plan	Step 6 RISB Action Plan via GIV	Open	19Jul2016	21Jul2016	21Jul2016	.	.	99	7	0
A_1001	Management needs to provide an ongoing monitoring plan	Management needs to provide an ongoing monitoring plan	Pending	.	15Mar2015	.	.	.	27	.	0
A_10011	Step 7 RISB Action Plan	Action Plan via Audit	Open	19Jul2016	19Jul2016	19Jul2016	.	.	90	9	0
A_10014	Action plan Risb audit	audit	Open	21Jul2016	22Jul2016	22Jul2016	.	.	126	6	0
A_10015	Subito Banca Store -	Demo Script	Open	21Jul2016	06Aug2016	06Aug2016	.	.	49	-9	0

Copyright © 2013, SAS Institute Inc. All rights reserved.

sas THE POWER TO KNOW.

Obrigado