

Financial Risk Management and Model-Based Design



Ray O'Brien

**COO of Global Risk
Head of Global Risk Analytics**

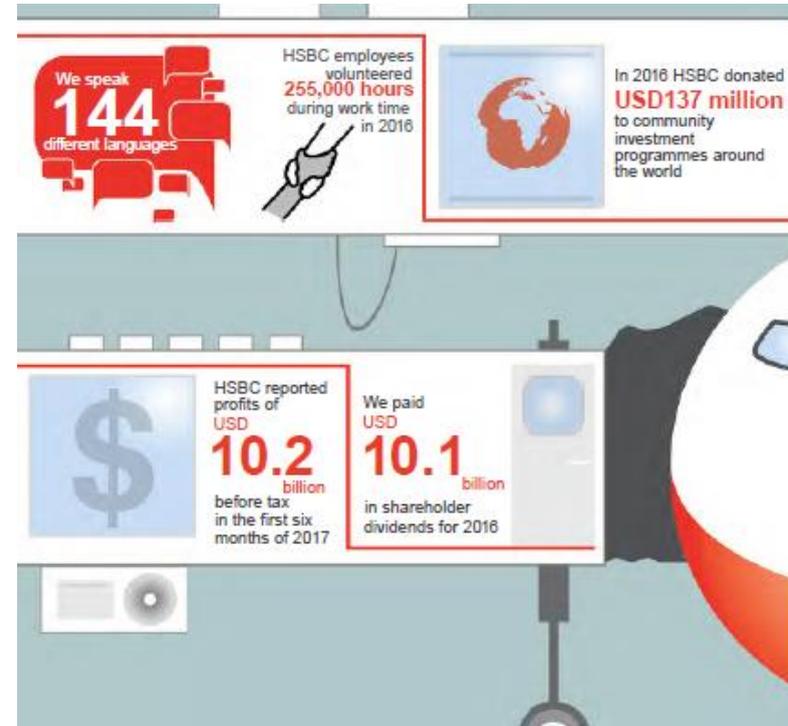
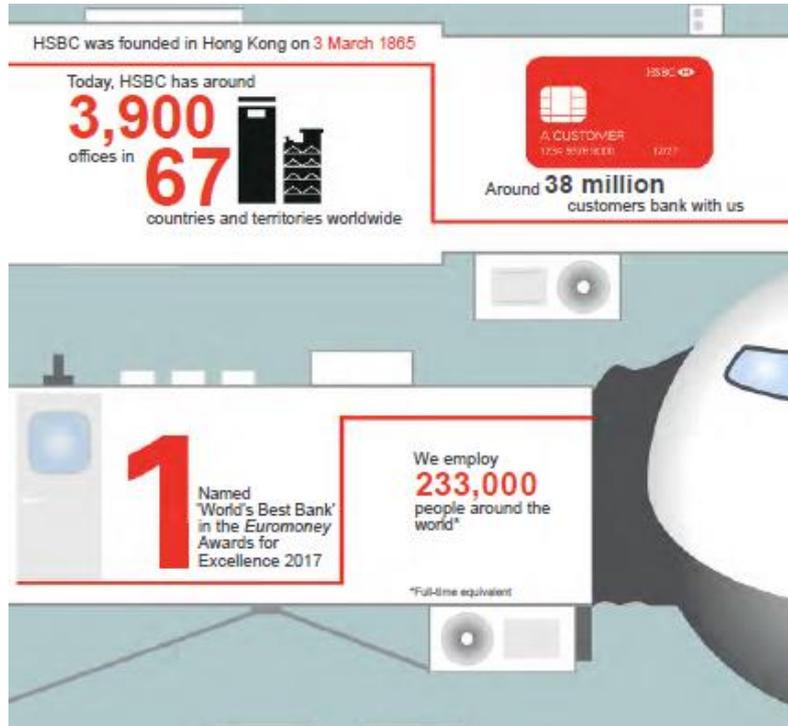


Introducing HSBC

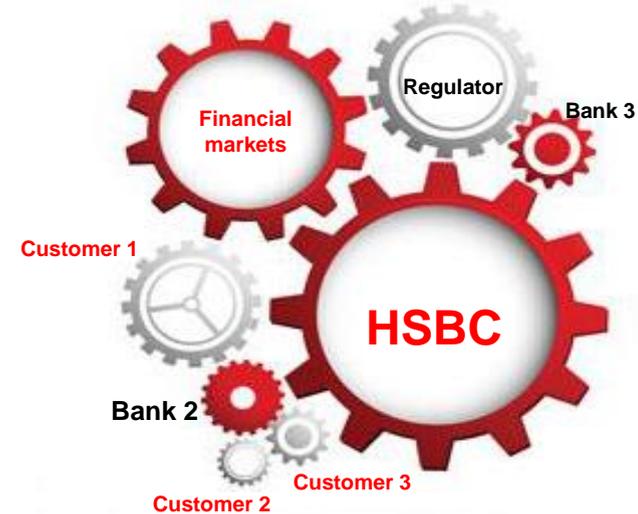


HSBC – today

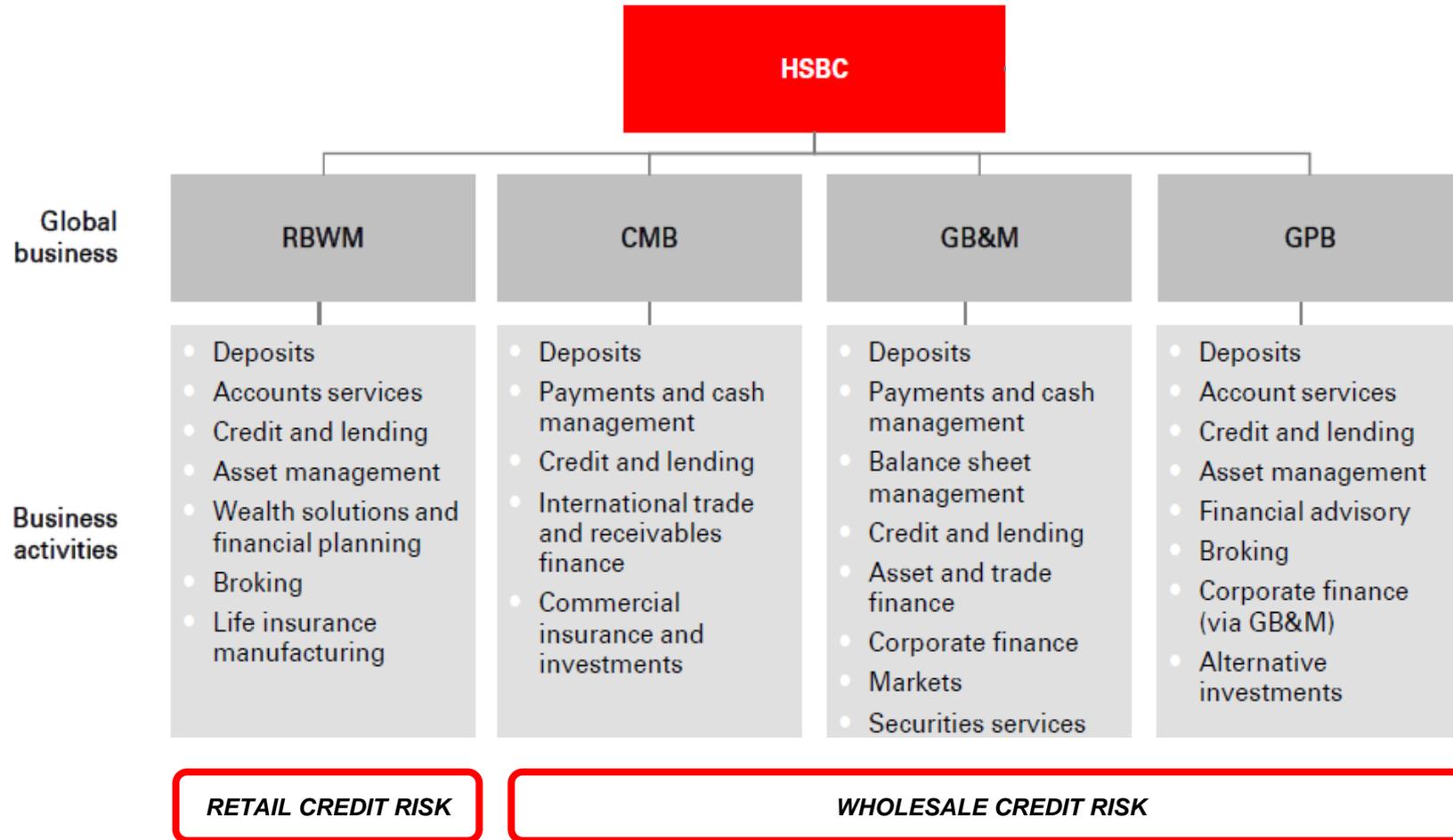
One of the world's most important global financial institutions



HSBC is a market participant within the wider financial system



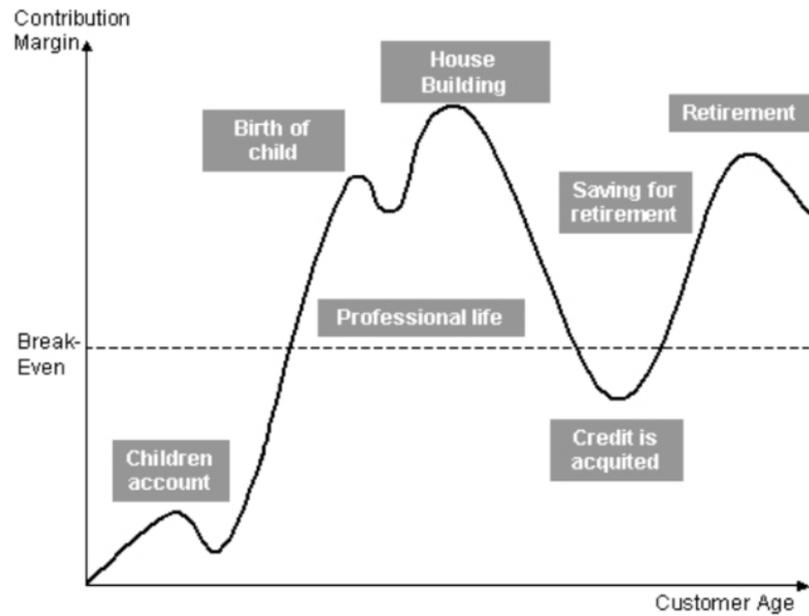
How is HSBC Structured as a Bank?



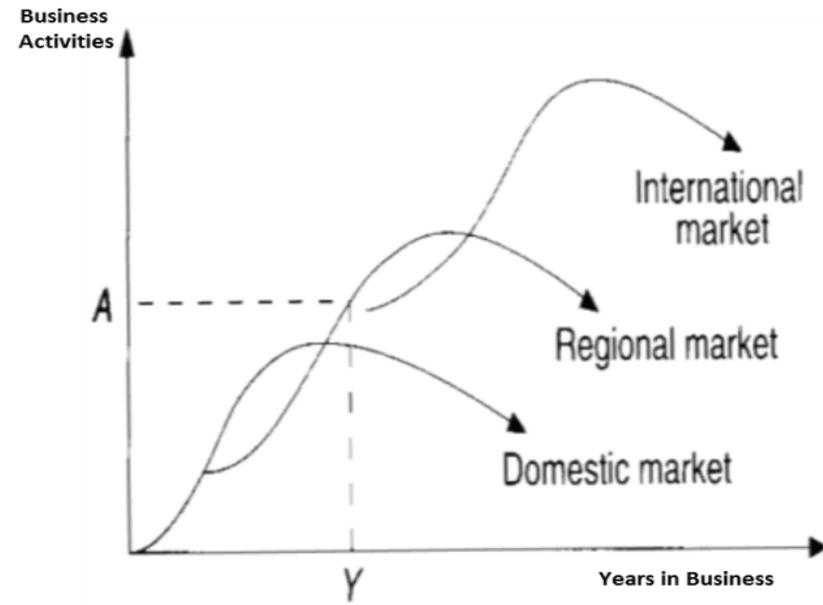
Introduction to Wholesale Credit Risk

Relationship Life-cycle (Retail vs Corporate)

Individual Customer



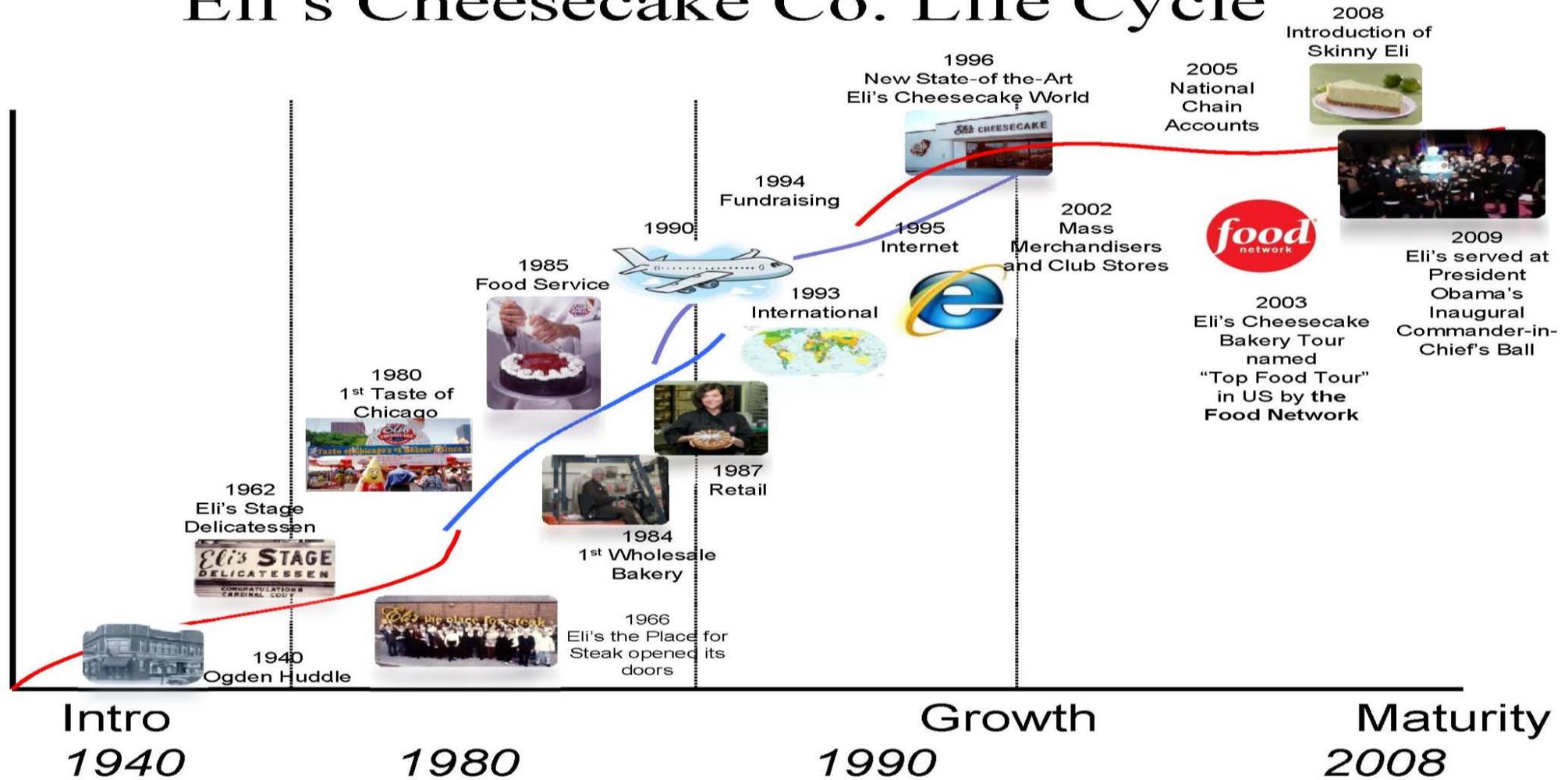
Commercial Customer



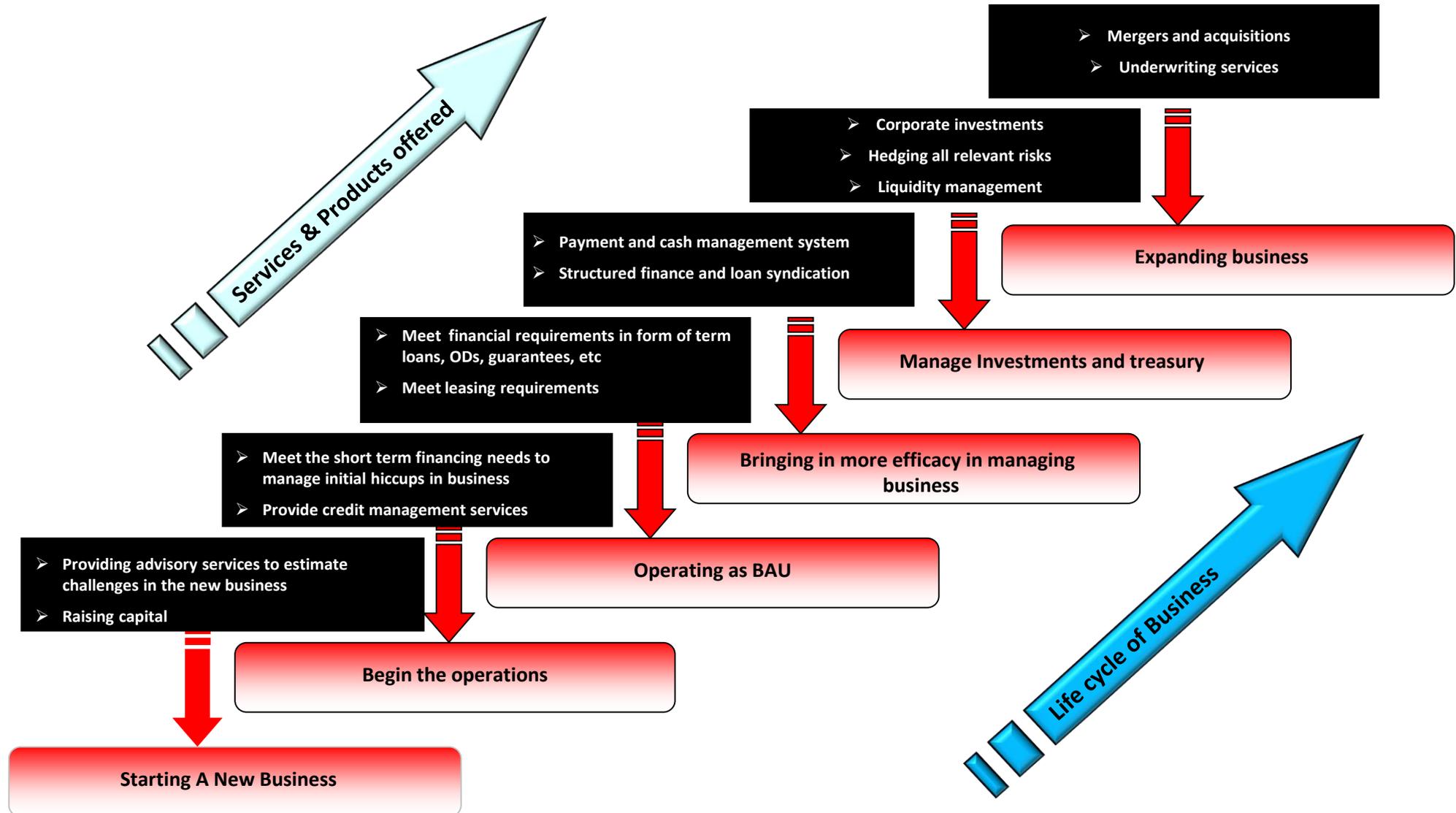
Customer Maturity Life Cycle

An example with Eli's cheesecake factory

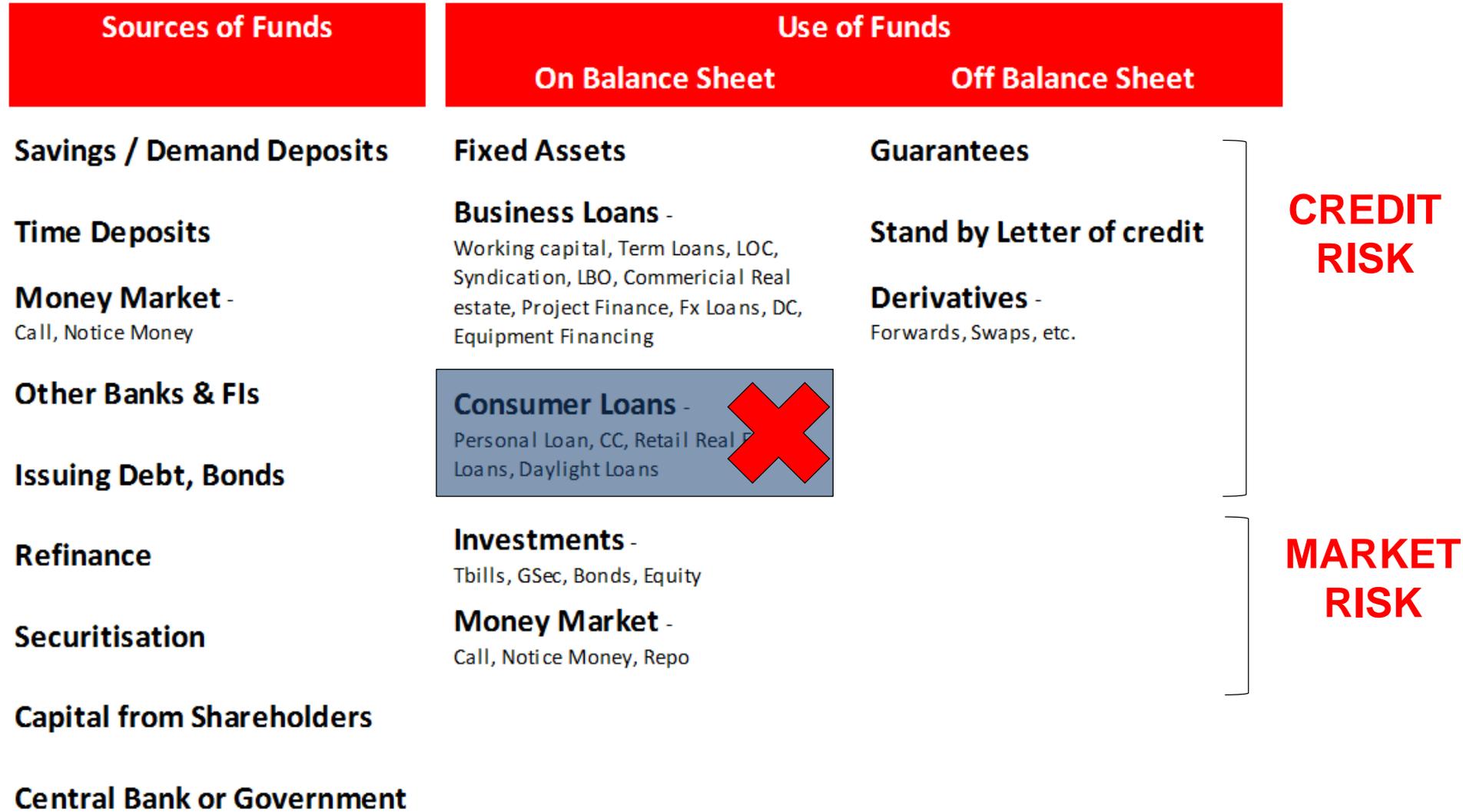
Eli's Cheesecake Co. Life Cycle



Corporate Customer Journey and Banking Needs



Wholesale Banking Balance Sheet Composition and Risk Types



Global Risk Analytics

Global Risk Analytics

Our global function supports HSBC's global businesses



Global team, with 650+ resources in 4 regions

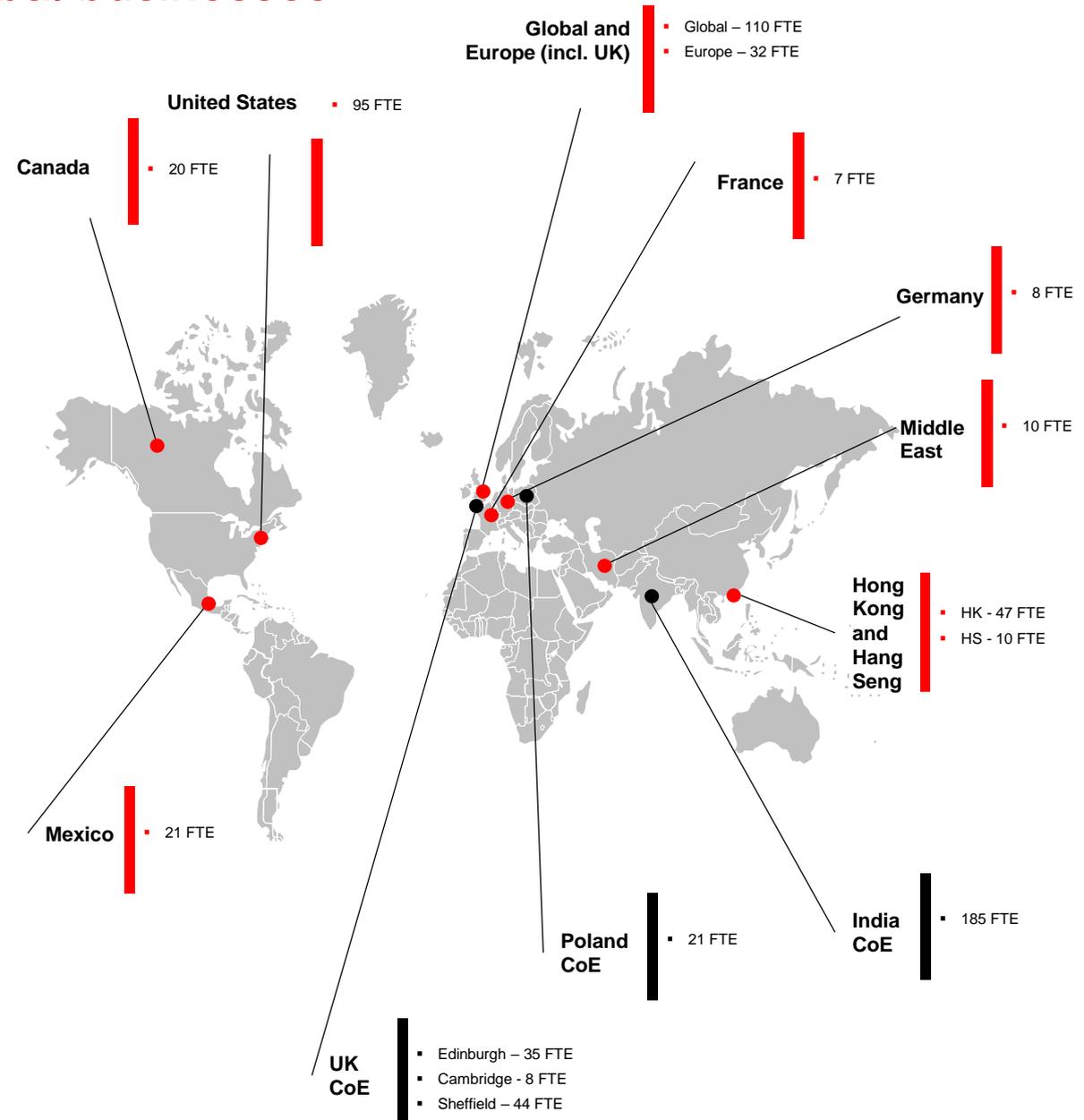


Global standards, driving consistency



Strong incentive for staff mobility

Just as HSBC is a global business, GRA is a global function, with 650+ staff in offices across 17 cities in 10 countries. We provide support to all of the 67 countries and territories in which HSBC operates.



Sharing best practice and driving Risk Analytics innovation at HSBC

Risk exists in client relationships, our product offering, the markets we participate in and resulting transactions. These risks need to be identified, then measured, monitored and managed within the bank's appetite and tolerance.

What is our Purpose?

- Provide cutting-edge tools to help manage risk and ensure compliance with both our internal policies and the requirements of our regulators.

Our Objectives are simple

- We build and manage solutions (models) to meet business & client needs, and provide end-to-end management of the models' lifecycle, ensuring governance, control and appropriate usage.

Model Risk Management Framework

HSBC's Model Risk Management Framework underpins everything GRA do. It ensures appropriate model risk management policies and governance framework exist; that models are developed and implemented robustly and appropriately; and that those models undergo appropriate validation and independent reviews pre and post implementation.

Notes

1 - Understand the reasons behind the creation of a model and the expectations for how the model output will be used

2 - Model is logical, developed robustly and appropriately for its intended purpose and is consistent with global standards.

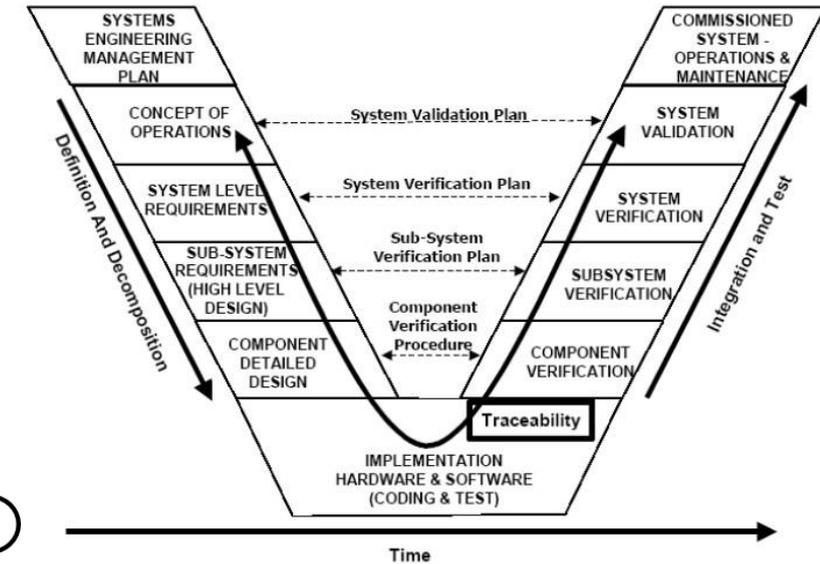
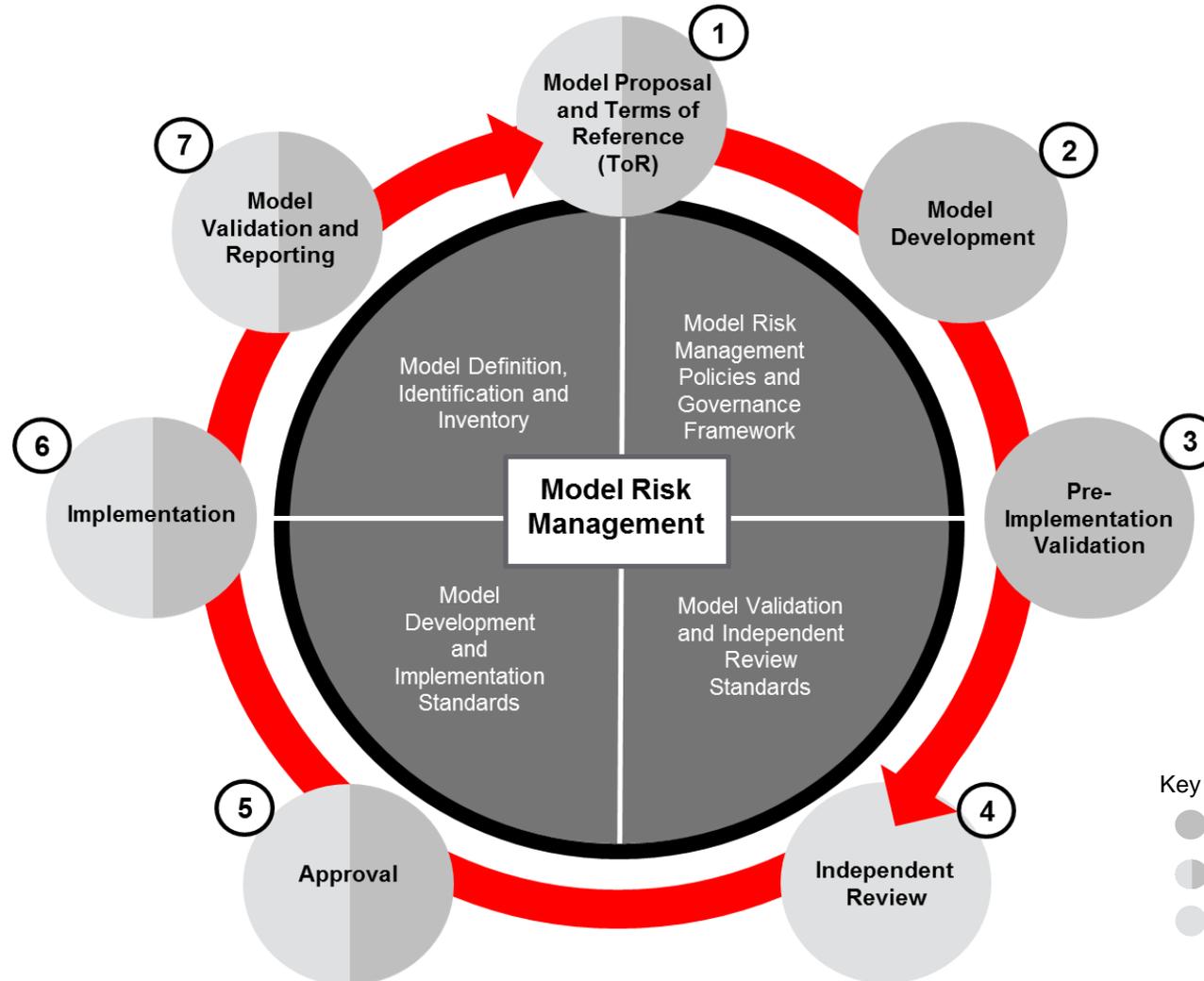
3 - FLOD control to ensure model is conceptually sound, data used is appropriate and results meet intended purpose

4 - SLOD control where key models undergo an independent review to provide credible challenge and additional assurance to management, helping to identify limitations prior to model's use.

5 - Model has received appropriate approval from the relevant authority or accountable individual(s) before use or implementation of the model

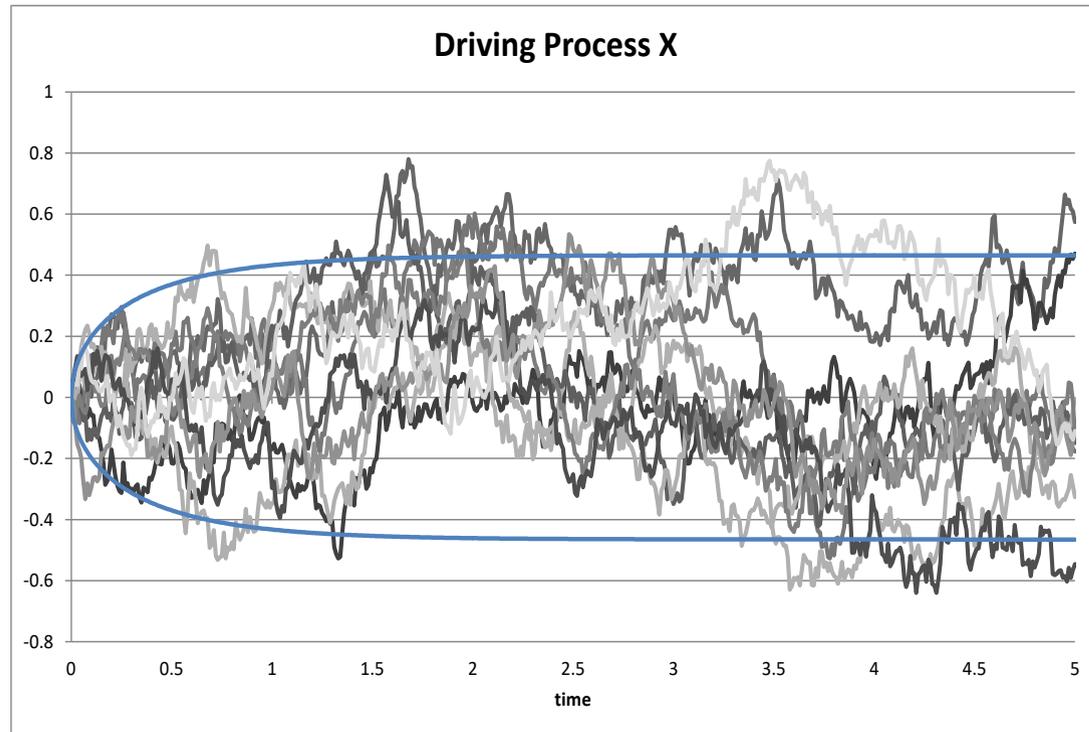
6 - Model has been implemented as per its original design and purpose and that appropriate testing have been performed before implementation

7 - Model is performing satisfactorily and being used as per its original design and purpose. This includes a number of activities including first line monitoring and validation, and independent validation and review



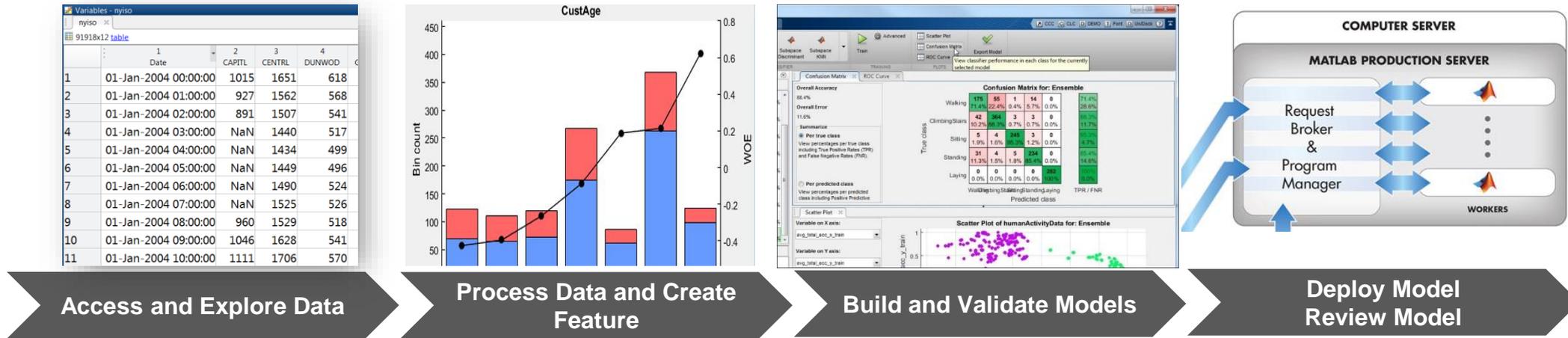
Compared to the Model Based Design V Diagram...

- Key
- GRA responsibility
 - Joint GRA responsibility
 - Non GRA responsibility



- The trading book contains long-dated transactions.
 - We need to simulate potential market outcomes to maturity of transaction (up to 70 years).
 - The current approach is to consider 1,000 outcomes at up to 135 future time points.
-
- The result is that we need to re-calculate the portfolio up to **135,000 times**.
 - This highly quantitative process requires extreme optimisation of simulation, pricing and aggregation algorithms.

Our journey with MathWorks



- Today, more time spent processing data than building models.
- Automation: finding data, generating reports, recoding models
- High cost of incorrect data assumptions causing models to be rejected by regulator.
- Need to iterate rapidly.

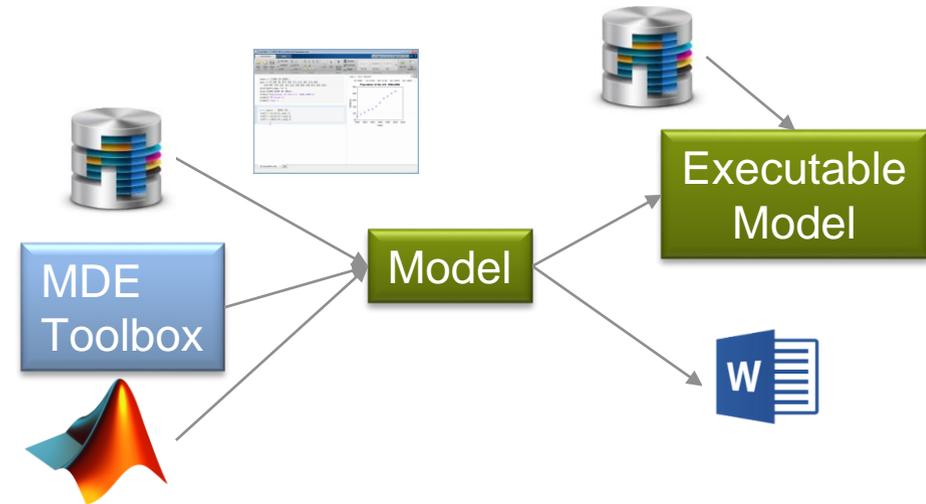
Mission: ***Improve the pace, transparency and reproducibility of the model development and review processes through user-friendly tools that encourage a consistent approach.***

What are the pain points?

- Pace of building and reviewing models
- Ability to reproduce results
- Consistency of modeling approaches

What is the solution?

- MATLAB toolbox for risk modelling at HSBC
- Functions, apps, demos, and documentation
- Supports all stages of the workflow
- Leverages MATLAB toolboxes
- Target users: risk modellers and analysts
- Aims: improve pace, transparency, accuracy, reproducibility, consistency



The screenshot displays the MATLAB R2016a interface for the Model Development Environment (MDE). The main window is titled "EDA Viewer" and shows the "Exploratory Data Analysis" stage. The EDA Stages dropdown is set to "Univariate Plots Analysis 2(Factors)".

The EDA stage displays three plots for factor F_CtryScr:

- Year-by-year factor coverage, emphasis on F_CtryScr:** A line plot showing Percent Coverage (0 to 80) over Date (1994 to 2014). The coverage starts near 0, rises to a peak of approximately 80% around 2012, and then declines.
- Cross-sectional distribution of factor F_CtryScr:** A bar chart showing Factor Value (1.5 to 5) over Date (1994 to 2013). The values fluctuate between approximately 2 and 4.5.
- Smoothed, cross-sectional PDF for F_CtryScr:** A probability density plot showing Probability Density (0 to 1.2) over Factor Value (-5 to 10). Multiple colored lines represent different years from 1994 to 2009, showing a distribution centered around 2-3.

Below the plots are three input fields for Name and Date, each with a "Post as new comment" button.

The right side of the interface shows the "Script Builder" workspace with a tree view of the project structure:

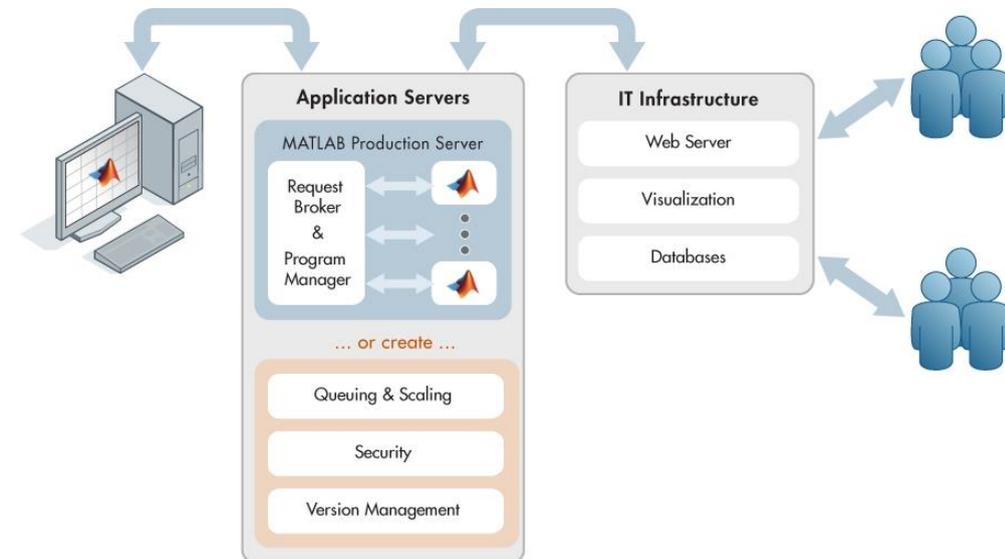
- 03 Exploratory Data Analysis
- 04 Subsampling
- 05 Feature Selection
- 06 Candidate Model Generation
 - Common Operations
 - Learners Library
 - Calibration Learners
 - Embedded Learners
 - Multi Modelling
 - Advanced_Blended_Learner.m
 - Advanced_Segmented_Learner.m
 - Binning_Transformation.m
 - Parallel_Learner.m
 - Serial_Learner.m

The "Performance Assessment" window is open, showing a table of results for Train and Test sets. The table includes columns for various metrics (A, B, K, Ac, Ad, AI, AU, Bi, Br, K) and rows for Combined, Segmented, and F4 models.

Below the table, the "ROC for model Segmented" plot is displayed, showing True Positive Rate (0 to 1) versus False Positive Rate (0 to 1). The plot compares Training (blue line) and Testing (orange line) performance. Both curves are significantly above the diagonal, indicating good model performance.

The bottom left shows the "Current Folder" pane with files like .gitignore, 00PreparedDataSet.mat, and 1VariablesLoaded.FlowProject. The "Command Window" is also visible.

- Includes MATLAB Production Server in HSBC's production environment
- APIS and conventions for calling models
- Infrastructure to connect directly to production data sources
- Runs legacy models and models built using MDE



Model Execution Environment (MEE/wREN)

HSBC wREN interface showing a list of rating events. The interface includes a filter bar at the top with options: "Leave blank to show all", "Active only", "Just mine", and "Recently changed". Below the filter is a "Create new Rating Event" button. The main content area displays a list of rating events, each with a company name, proposed rating, owner, and last modified date.

Company Name	Proposed Rating	Owner	Last Modified
GHABOUR CONTENENTAL FOR TRAD	6.2	Gamil Magdy Esmal Mahmoud Hassan (43515501)	07 Sep 2017 at 15:13:32
AATCO FOOD INDUSTRIES LLC	4.3	Ajay Kumar Goudperi (43153993)	07 Sep 2017 at 14:56:43
AL KHALIL UNITED ENTERPRISE	3.3	Ajay Kumar Goudperi (43153993)	07 Sep 2017 at 14:04:03
AMANA CONTRACTING & TRD CO L	5.1	Raghraksh M.K (43594319)	07 Sep 2017 at 10:05:01
GULF AGENCY CO (BAHRAIN) WLL	4.1	SUJANA M N V M N V (43673362)	07 Sep 2017 at 06:48:51
GULF AGENCY CO (OMAN) LLC	3.2	SUJANA M N V M N V (43673362)	07 Sep 2017 at 06:39:28
SAHARA PETROLEUM SERVICES CO	5.1	Manar Mahmoud Ezz-Eldin Abo-Saleh (43597122)	06 Sep 2017 at 07:50:49
TOSHBA ELARABY VISUAL PROD.	5.1		

HSBC wREN interface showing a rating event detail view. The interface includes a navigation bar with tabs: "Rating Approach", "Raw Rating", "Modifiers", and "Approval". The main content area displays customer information, general information, and operations.

Customer:
GHABOUR CONTENENTAL FOR TRAD
1 Local Alias
GHABOUR CONTENENTAL FOR TRAD
HUBEG: EGHKEB001492917

HSBC Legal entity: HSBC Bank Egypt S.A.E.
Regulator: CBE

Local credit approval: Using MENA Regional PD (v2)

General information

Country of risk: Egypt

Operations

Sales to high risk countries: None
Trading Area: Local
Business Diversity: 3-5 major businesses
Competitive Edge: Strong

HSBC wREN interface showing a rating event detail view. The interface includes a navigation bar with tabs: "Rating Approach", "Raw Rating", "Modifiers", and "Approval". The main content area displays operating environment details and model result details.

Operating Environment

Years in Business: > 20 years
Credit history: Clear history
Risk of adverse events: Average
Account Conduct: Satisfactory
Barriers to Entry: High
Competitive Structure of Market: Highly Competitive

Model Result Details

Generated Rating: 6.2

Report level data

Credit Officer's report

Rating Event Proposed and waiting for approval

HSBC wREN interface showing a model explorer table. The table displays various factors and their values.

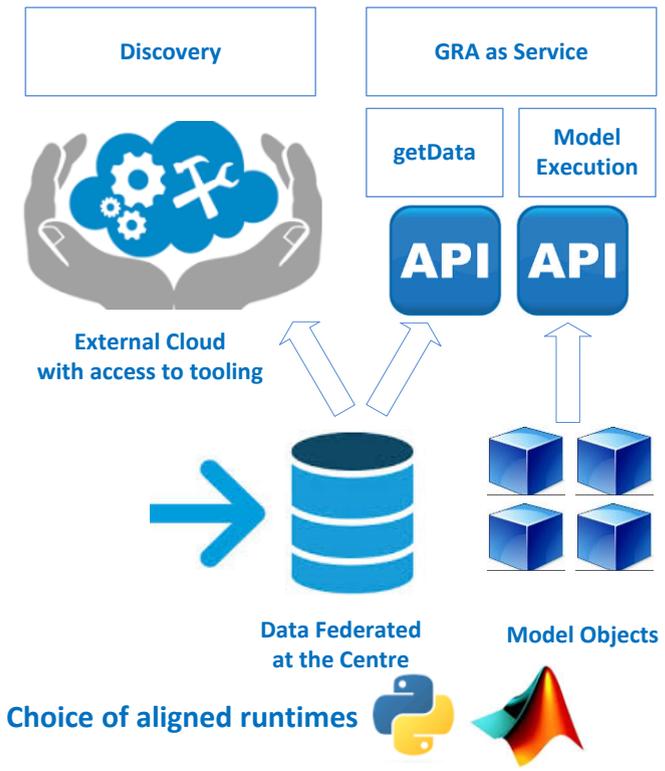
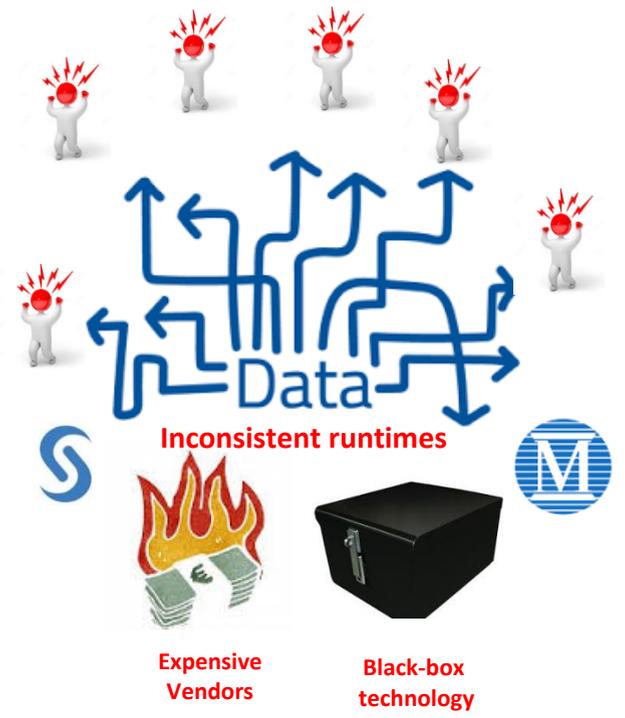
Type	Label	Value
Model	MENA-PD	6.2
Model	Model Score	492.4
Factor	Financial Industry Country Score	396.49254816553656
Factor	Factor: Financial Industry Country Log-odds	-3.766572733379939
Factor	Financial Industry Score	446.50922390249195
Factor	Financial Score	440.56580433610213
Factor	Factor: Non-normalized Financial Score	0.8165566709055269
Factor	Constant: Regression coefficient for r_104	0.176779057
Factor	Constant: Regression coefficient for r_720	0.1234833
Factor	Constant: Regression coefficient for r_607	0.143188526
Factor	Constant: Regression coefficient for r_402	0.1646444
Factor	Constant: Regression coefficient for r_622	0.0915543051
Factor	Constant: Regression coefficient for r_702	0.1646444
Factor	Constant: Regression coefficient for r_806	0.136190984
Factor	Factor: Standardized_r_104	-0.8729624966824914
Factor	Factor: Standardized_r_607	0.40183240904895023
Factor	Factor: Standardized_r_622	-0.550738014647397
Factor	Factor: Standardized_r_720	1.253308753014446
Factor	Factor: Standardized_r_702	1.7078079788783755
Factor	Factor: Standardized_r_806	1.845849634055966

GRA in a SLIDE

FROM THIS  TO THIS 

Poor Quality Models
Regulatory Scrutiny
High Cost
Inconsistency
Frustrated Users

SDLC Vendor
Driven



Reduced Cycle Time
Access to Tooling
Freedom to Analyse
Consistency
Lineage & Tractability
Low Cost

Agile/DevOps
Focused

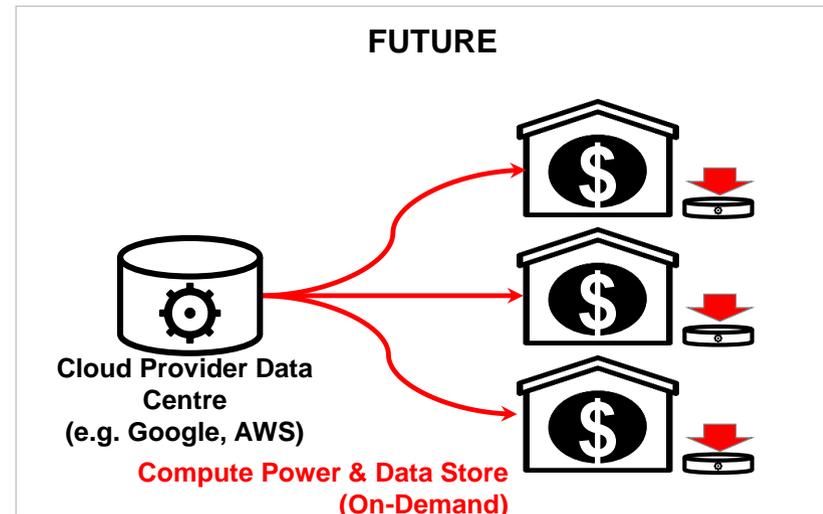
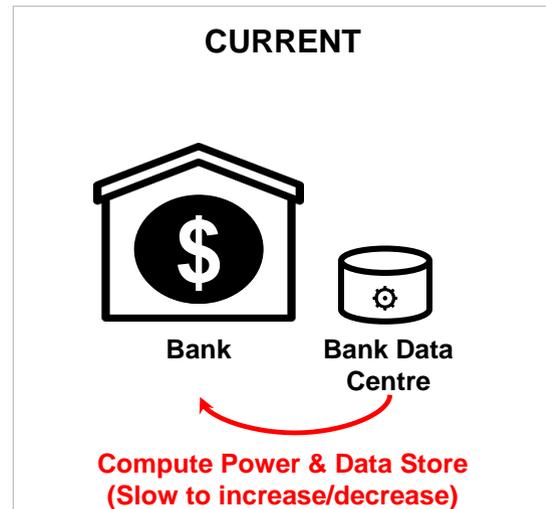


What Else?
Cloud Adoption

Cloud Adoption

Benefits of using cloud

- **Analytics requires significant compute power** yet this **demand is not always consistent**. Cloud allows compute power on-demand which we can use for a finite period and then demise.
- Cloud greatly increases the **speed that we can acquire additional compute power** (hours versus months under the traditional model of ordering our own servers) and **lower cost** (we only pay for what we use rather than idle time).
- Both **analytics and reporting processes can benefit from leveraging the cloud-based tools**. These are **typically cheaper** than our existing tools.
- Additionally, analytics and reporting can both benefit from the **additional security offered by the cloud** over our existing infrastructure and **improved collaboration** across legal entities and geographical boundaries.



Cloud Adoption

What are the use cases for cloud within Global Risk Analytics?

**Elastic
Compute**

**Cloud Based
Reporting**

**Collaborating
with FinTechs
& Academics**

**Rebuilding
Analytical Models**

Machine Learning



Cloud Adoption

Where are we now and what's next?

- Since December 2016, we have:
 - ✓ Completed the initial batch of proof of concepts:
 - ✓ **Rebuilding risk reports** using dummy data on Google and MS Azure cloud.
 - ✓ **Testing elastic compute** for RAVEN CR on AWS and Google using dummy data
 - ✓ **De-sensitising production data** so that it can be shared with academics
 - ✓ **Creating scalable cloud environments** to run analytics using MATLAB
 - ✓ Set-up a **production environment in AWS Cloud with unmasked production data and MATLAB** for both Economic Capital (Op Risk) and Economic Capital (Credit – UK).
- Our **focus for H2 2017 is:**
 - Providing cloud environments to our **Innovation Champions** to run **proof of concepts**.
 - **Scaling up production migrations** to cloud.
 - This will mean providing both our **business and IT colleagues** across Global Risk with **appropriate training** to use AWS and Google.

