The LDA-based Advanced Measurement Approach for Operational Risk – Current and In Progress Practice
RMG Conference
May 29, 2003

ABN AMRO
Banca Intesa
BNP Paribas
BMO Financial Group
Crédit Lyonnais
Citigroup
Deutsche Bank
ING
JP Morgan Chase
RBC Financial Group
Royal Bank of Scotland
San Paolo IMI
Sumitomo Mitsui BC

ITWG

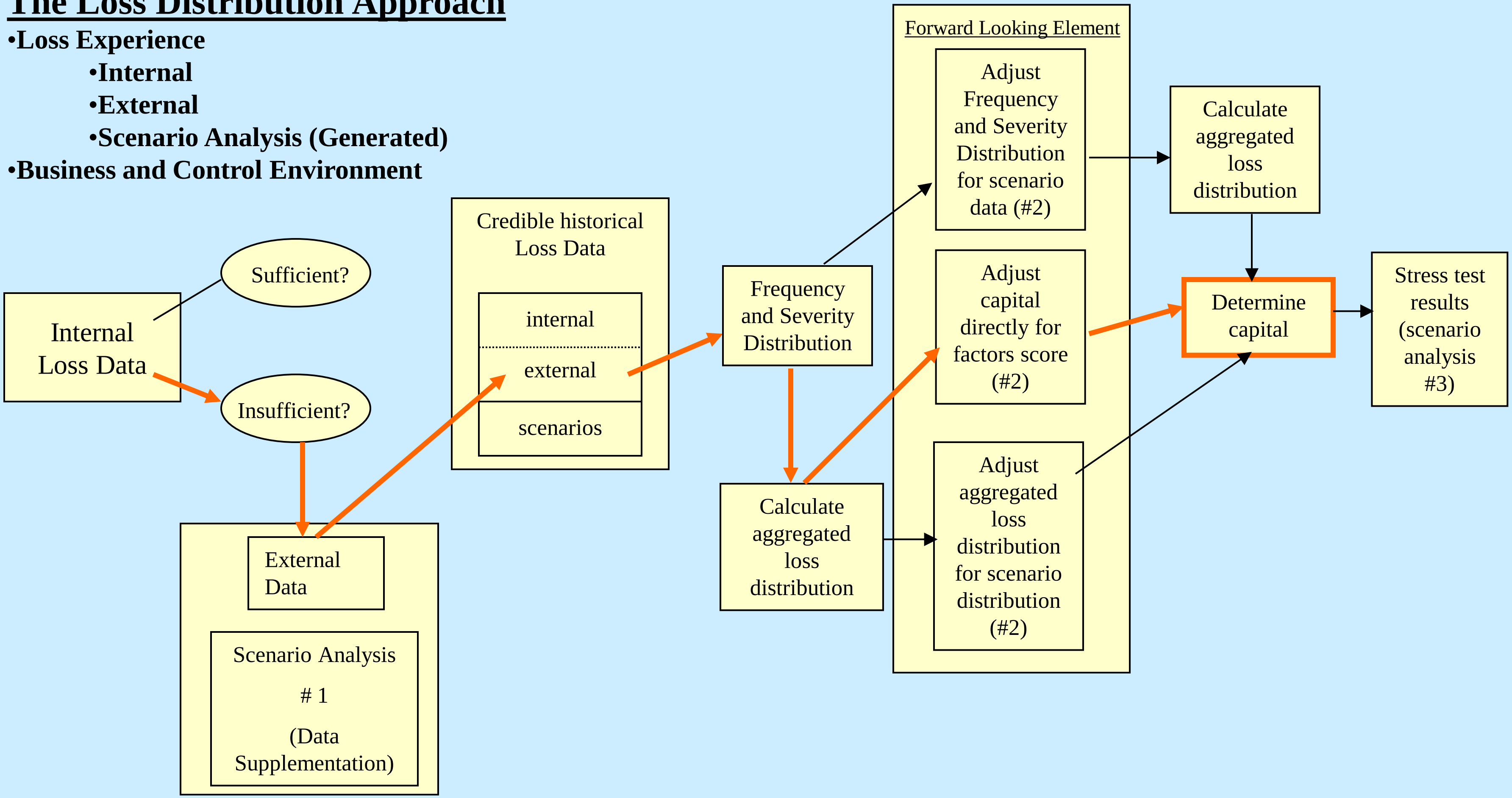
Objective: Propose solutions for key challenges in implementing a credible LDA-based AMA

- ITWG is an independent group of operational risk professionals from leading global financial institutions around the world interested in sharing ideas on the measurement and management of operational risk
- Ideas shared here are those of the individual participants, and are not necessarily endorsed by their institutions
- Ideas presented here are supported by a companion paper, which gives a more complete treatment of the challenges raised here as well as provides an overview of what participant banks view as "implemented practice" today
- ITWG members believe that loss data is the foundation of the LDA based AMA approach, and this premise underlies all our work
- Our objective in this presentation is to present some of the key challenges in creating a credible loss distribution, incorporating the four elements of the AMA required by Basel regulators

Elements of an LDA based AMA approach

The Loss Distribution Approach

- **Loss Experience**
  - **Internal**
  - **External**
  - **Scenario Analysis (Generated)**
- **Business and Control Environment**

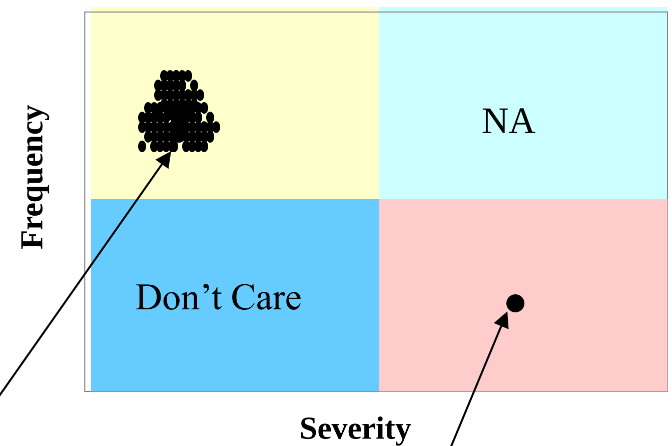


Is Internal Data sufficient?

For A Poisson Distribution 1082 individual data points are required to obtain an estimate of the expected loss within a 5% error and with 90% confidence

Number of Losses Required

	Confidence		
Error	99%	95%	90%
2.5%	10,623	6,147	4,326
5%	2,656	1,537	1,082
7.5%	1,180	683	481
10%	664	384	271



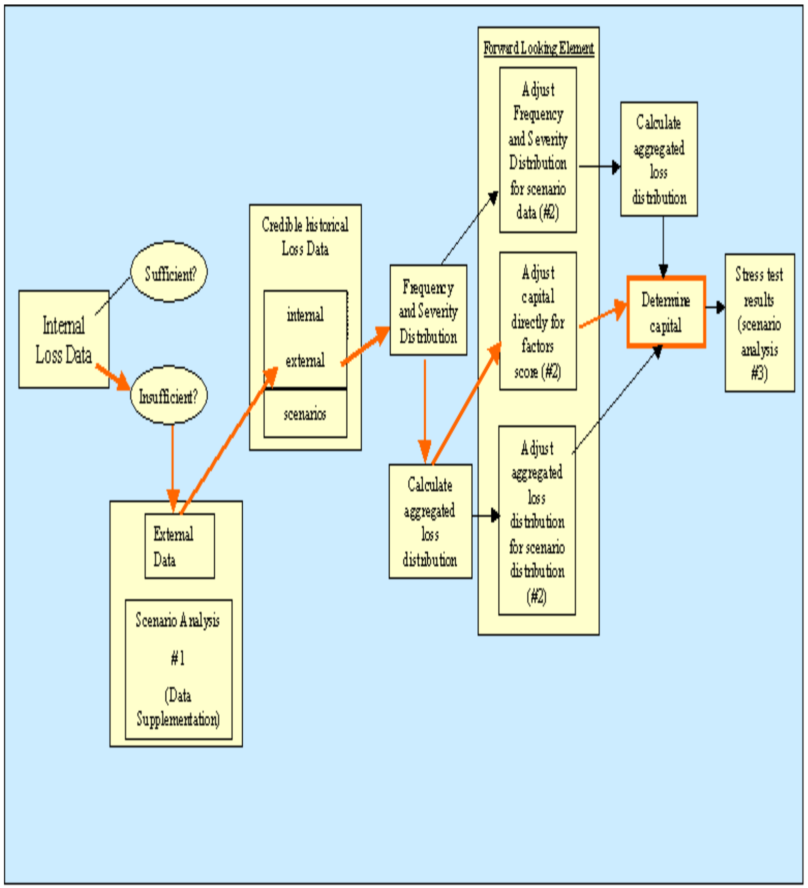
Standard curve fitting techniques

Many alternative non statistical techniques

Source:An introduction to credibility theory, Longley Cook : Casualty Actuarial Society

How 7 Banks Have Solved These Issues

All are based on the same foundations, however there is variation in emphasis of the components

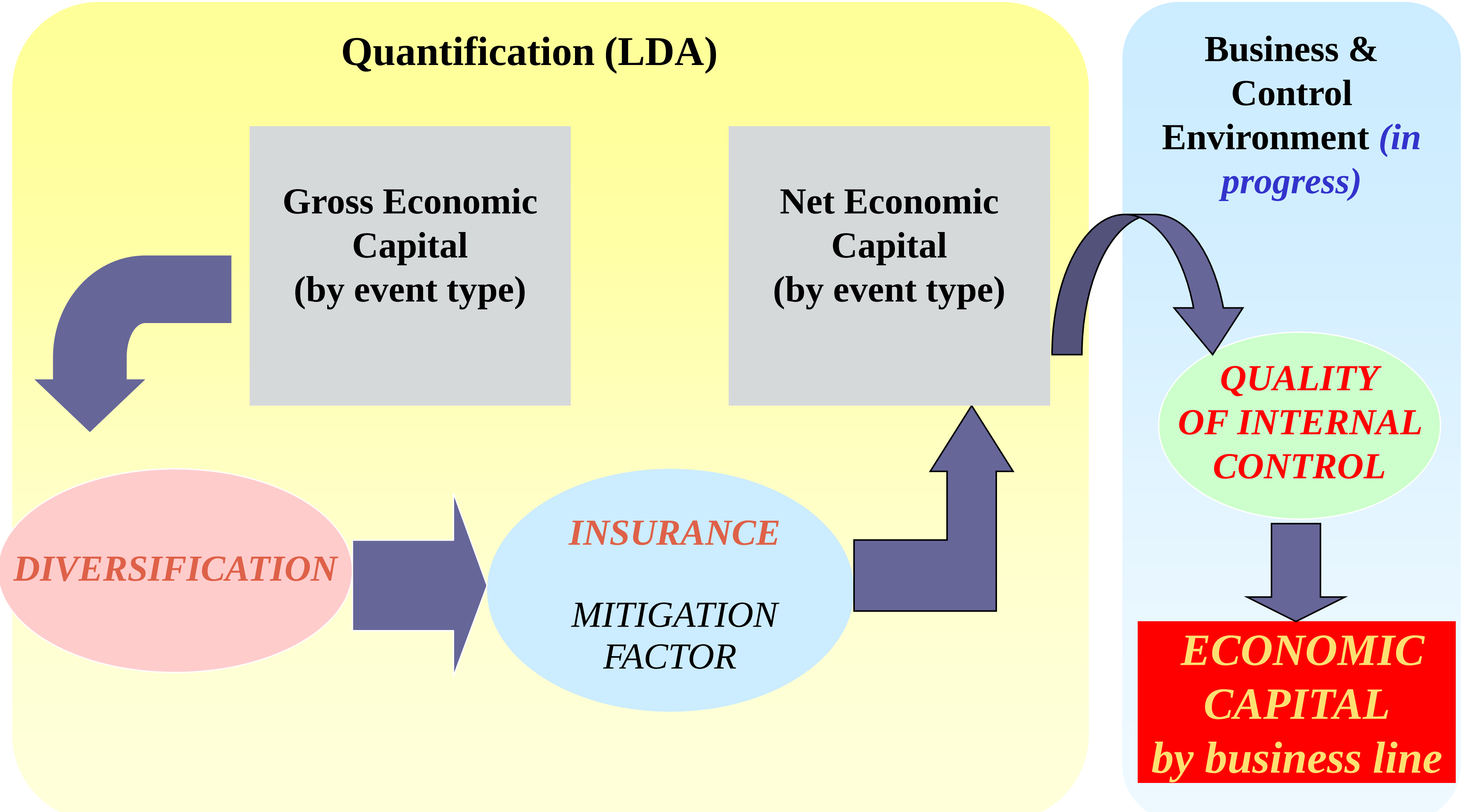


- an internal loss driven variation -> Credit Lyonnais-
- an actuarial driven variation ->Citigroup-
- an actuarial rating driven variation ->BMO-
- An external loss and Scorecard driven variation -> ING-
- A scenario driven variation -> Intesa
- A Methodology For Incorporating Bank-Specific Business Environment and Internal Control Factors-> ABNAMRO
- A Bootstrapping Methodology -> Sumitomo Mitsui BC

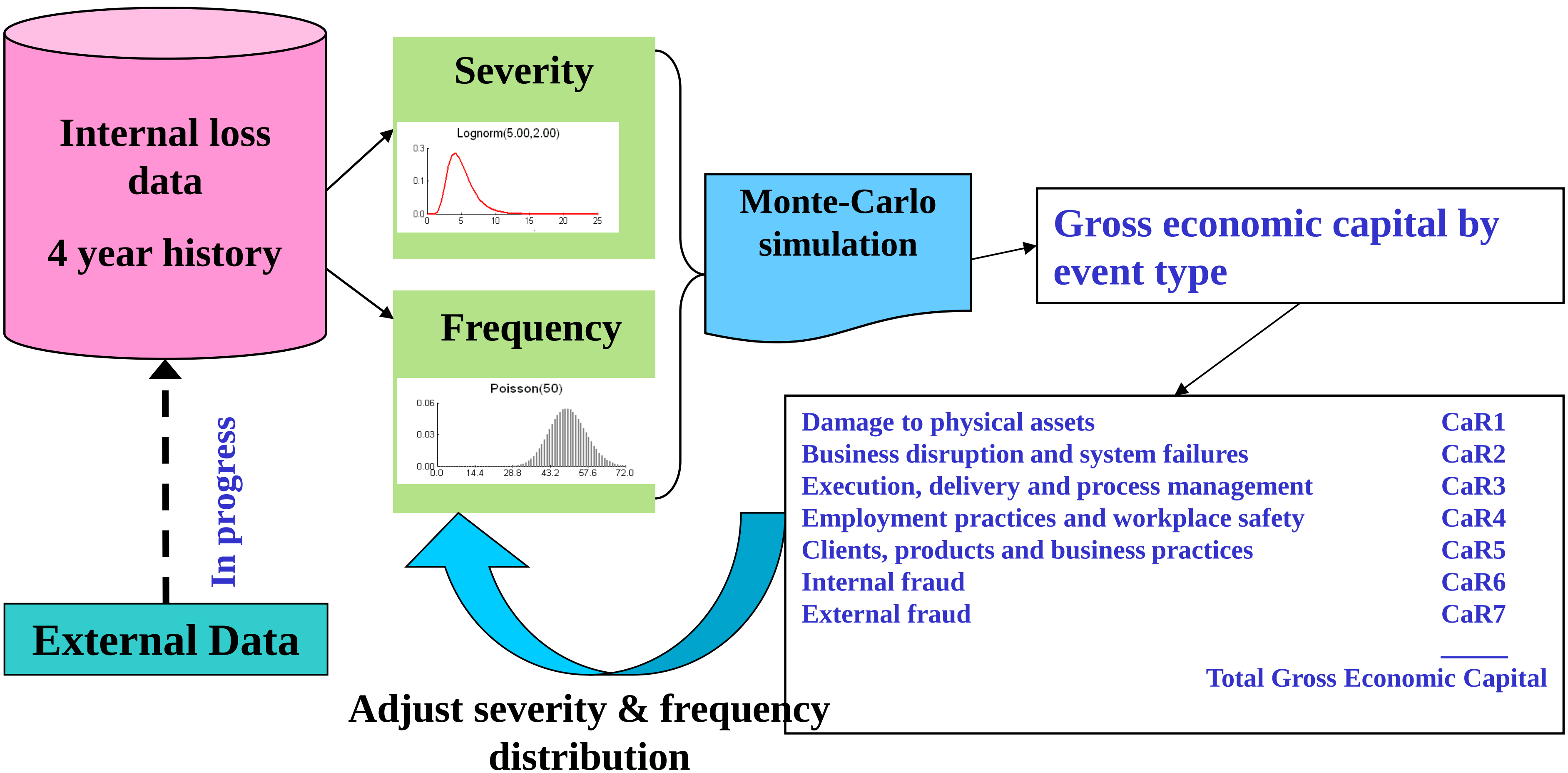
An Internal Loss Based Approach

AMA at Crédit Lyonnais - Overview

CREDIT LYONNAIS



Calculation of gross economic capital by event type



Quantification 2/2

Methodologies available at http://gro.creditlyonnais.fr

CREDIT LYONNAIS

- **Standard Actuarial-like Model with:**
  - **Frequency of events => Poisson**
  - **Severity => Log-Normal**
  - **Economic Capital is computed from a Monte-Carlo based engine**
- **Economic capital (EL + UL) computed with a one-year time horizon and 99.9 % percentile**
- **Data collection threshold = 1 k €**
- **Treatment of aggregated losses**
- **Adjustment of frequency and severity distributions**
- **Diversification with subjective estimates of correlation**
- **Insurance reduction by event type based on policy coverage and recovery history**

Implemented

- ***Supplementation with external data***
- ***Confidence Interval of CAR estimate***
- ***« Worst case » quantification***

In progress

Internal Control Environment

CREDIT LYONNAIS

Internal Control Self Assessment tool (VIGIE)
Business line / unit level

Business lines - Units	*Quality of self assessment*	*Action plan follow up*	*Internal control score*
Unit 1			80
Unit 2			70
Unit 3			85
Unit 4			88

- **Each unit gets today a rating combining qualitative indicators (e.g action plan follow up) and “quantitative” indicators (average score of internal control)**
- **This rating will be used as a key in the economic capital allocation process so that well rated B.L / units are rewarded with a reduction of economic capital**

An Actuarial Approach

End State: Adjusted Loss Distribution Approach

- Simulate an aggregate potential loss distribution for operational risk using an actuarial method
- Drivers of the simulation model include:
  - Probability distribution for N events [Frequency]
  - Potential loss distribution given an event [Severity]
  - These are obtained by fitting empirical loss data
- Economic Capital requirements are calculated as the difference between the expected loss level and the potential loss level:
  - At the target confidence level [99.XX%]
  - Over the defined time horizon [1 year]
- Split by business line and (if possible) by risk category
- Adjust for quality
- Calculate a correlated sum across business lines and risk types
- Full implementation depends on a robust data set, the collection of which is well underway

Adjustments to Baseline Capital

- Quality Adjustment Factor (QAF) is a function of Audit information:
  - Risk Level
  - Number of Business Issues
  - Severity of Business Issues
  - Number of days resolution is past due
- Control Quality Indicator under development will be a function of:
  - Quality Adjustment Factor
  - Qualitative data on business risk and control self-assessment
  - Key Risk Indicators
  - Scorecard methodology

Interim State: Placeholder Approach

- Implemented interim approach for use during current data collection phase
- Assessed potential losses due to unexpected operational loss events using external historical loss data
- Based initial capital figures on largest relevant loss events for each line of business, with some adjustments
- The simple total was then allocated according to the size of the business (Revenue) and its risk and control environment (Qualitative Adjustment Factor)
- Each period, the allocation is adjusted as a function of the square root of the change in size of the business and the change in the QAF
- Correlated sum is calculated across all business lines and risk types
- End result provides sound simple estimate of the "worst case" loss, reflects assumptions of relatively low correlation for operational risk, and moves up or down every period based on factors under the control of the business

An Actuarial Rating Approach

Implemented

For high frequency low severity losses

- an internal loss data approach ie credit card and other retail fraud

For low frequency high severity losses

• a scenario based approach for estimating expected frequency and severity

  - Estimates of frequency tend to be highly unstable ie dependent on respondent

Developing

Negotiating with two potential partners to develop an operational risk rating approach

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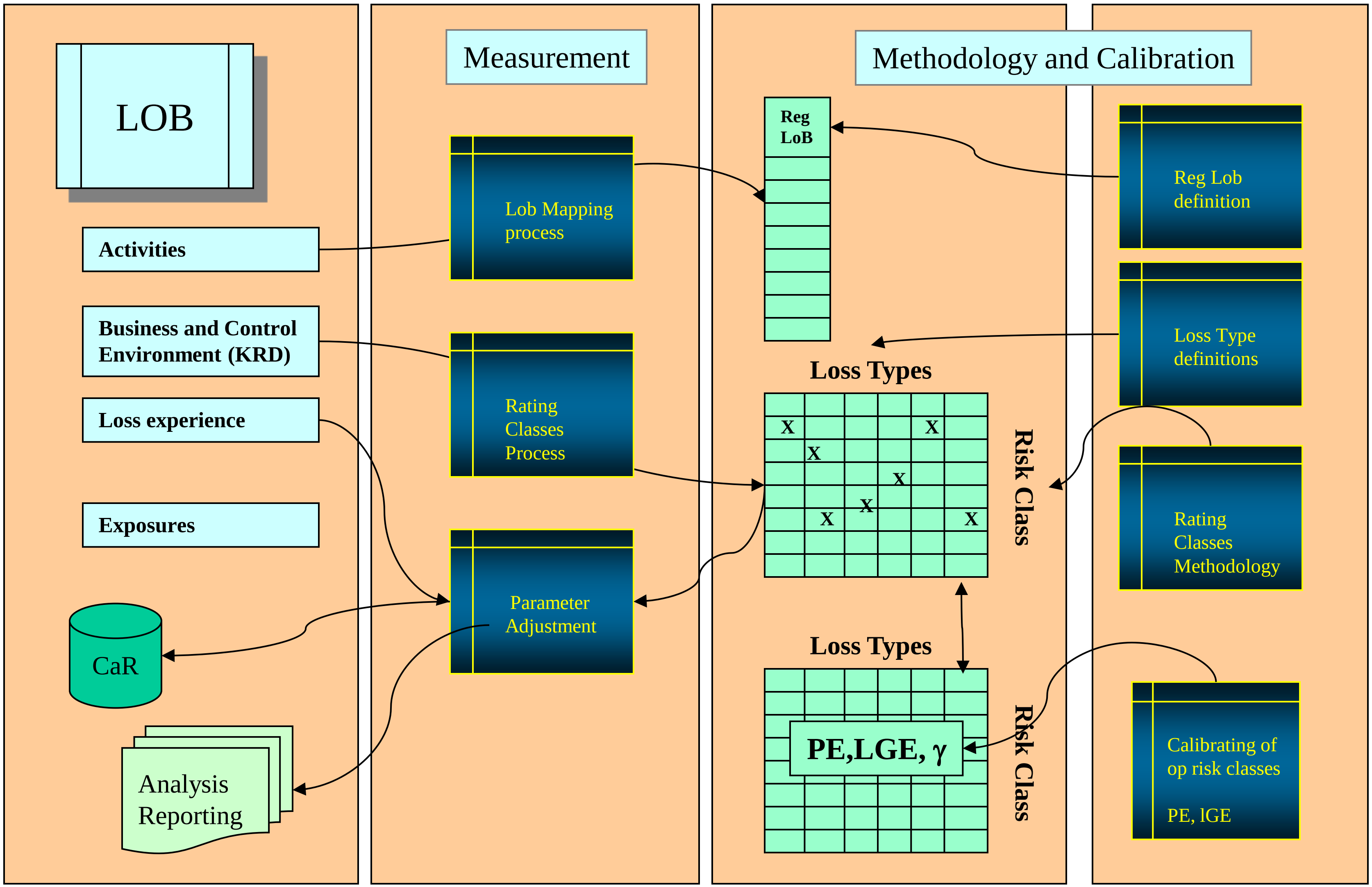
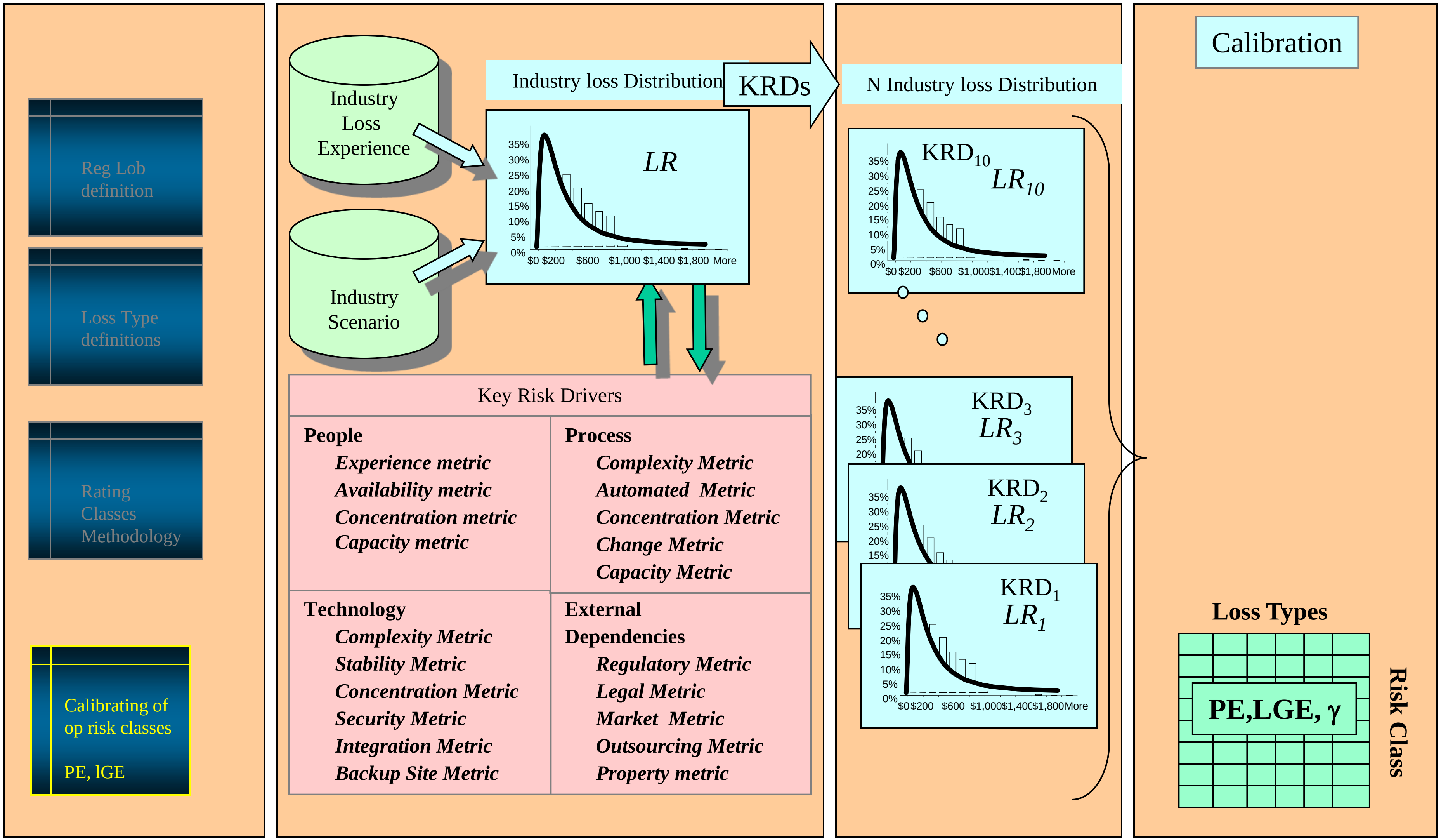
Measurement Methodology for Op VaR

BMO Financial Group



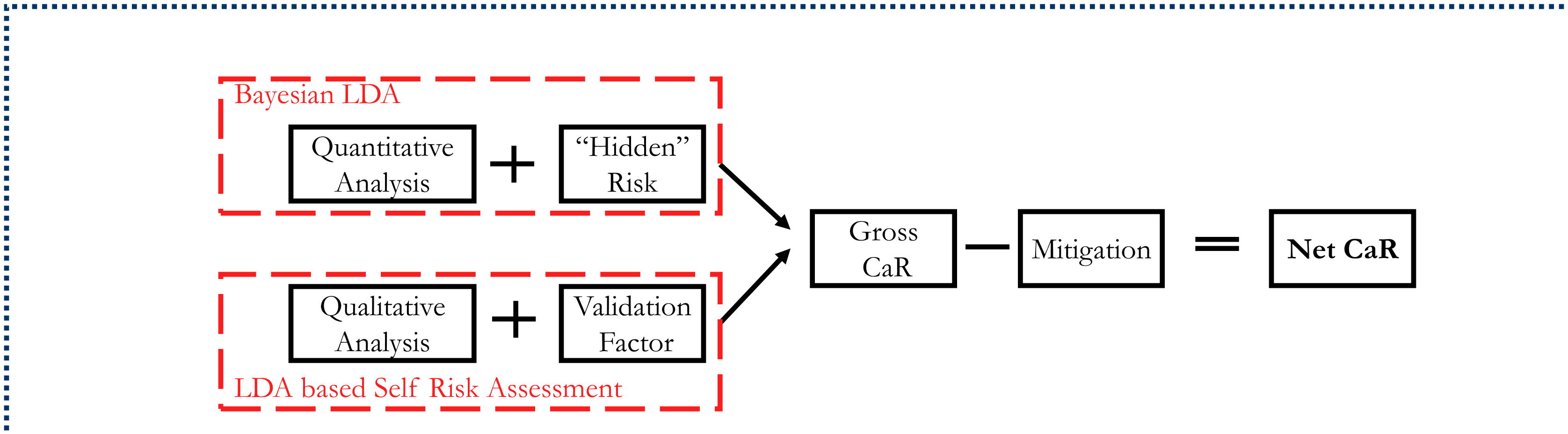
Calibration for Op VaR



A Scenario Based Approach

The AMA approach in Intesa

Banca Intesa



The Intesa Internal Model approach is designed to take into account all of the main components and analysis methods, and also to allow for the fact that a method may complement or substitute another or be used as a supplement. The use of all the components is key to ensuring a better understanding of the phenomenon

The Model principally relies on two "tracks": quantitative and qualitative analysis and is designed to use both of them according to relevance and quality

Overview of the LDA based SRA approach

Banca Intesa

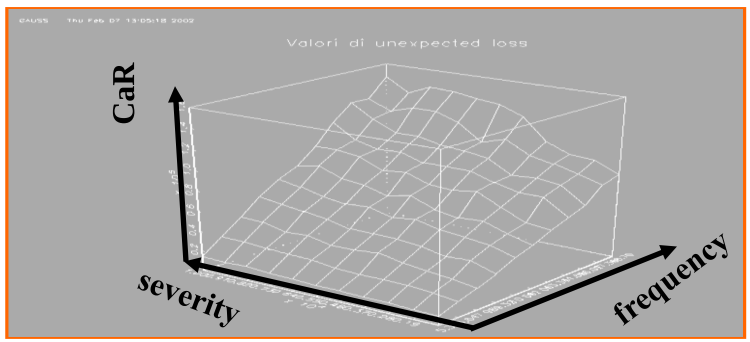
Input	Structure	Output

Subjective estimate of *"average frequency"*

Subjective estimate of *"average severity"*

Subjective estimate of *"worst case"*

Capital at Risk (CaR) Map



Cutoff (GI)

More accurate ranges of average severity & WC

Rating

OK	ALERT	RM CHECK	MITIGATION
A	B	C	D

Expected Loss Point Estimate & Confidence Interval

Unexpected Loss Point Estimate & Confidence Interval

Execution Phase – Self Risk Assessment

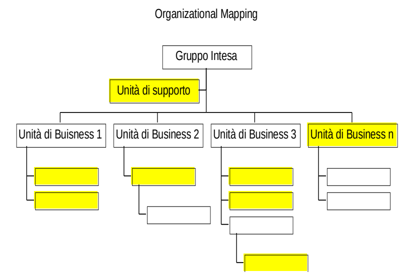
Each questionnaire refers to a part of the organisation based on the Intesa organisational mapping. The Head of each Division or department executes the assessment annually

The goal is to evaluate each BU's Risk profile: Risk is the combination of magnitude and probability of potential total loss over a given time horizon.

Potential total loss over a given time horizon is described by the severity of a single loss event and the frequency of events

The scenario forms are divided into sections (Risk Factors) We have identified 9 risk factors (critical resources which could be exposed to threats)

The scenario forms (questionnaires) are distributed by an Intranet based (Java) assessment tool (GAS) developed in-house with on-line help



Self Risk Assessment

Scenario			
Risk Class	Employer	Scenario N°	1
Scenario Description	Are you exposed to the risk of suffering losses linked to frauds/illegal intentional acts by employees?		
Answer	YES		
Assessment			
Average Frequency		Average Severity	
Worst Case Lower Boundery	0	Worst Case Upper Boundery	0
Worst Case level			
Note			
Exposure			
Vulnerability Type		Other vulnerability	
Internal Control			
Mitigation			
Mitigation's State			
Mitigation Type		Other mitigation	
Mitigation Description		Mitigation Date	

There are a number of ways to qualitatively validate scenario results

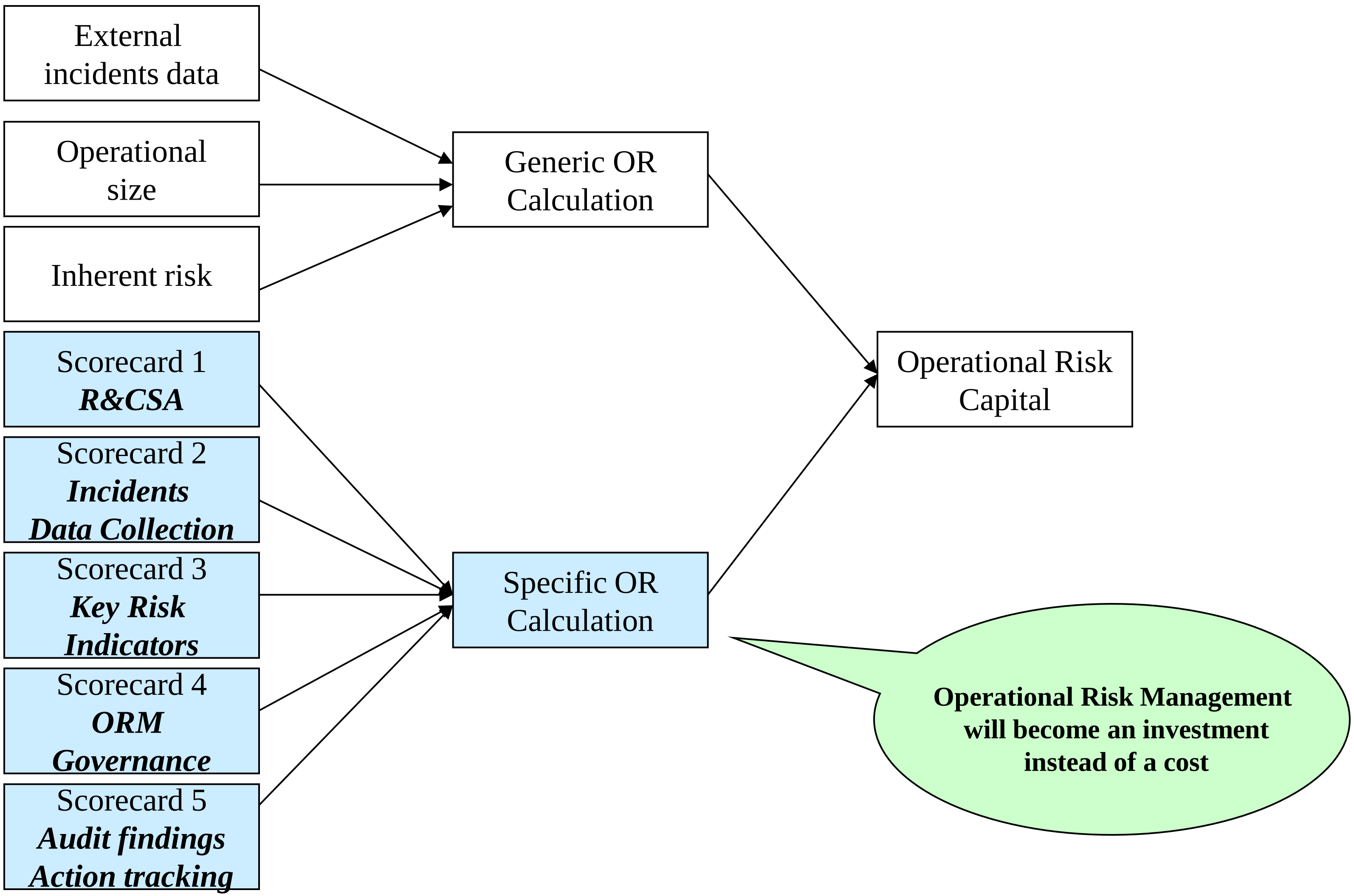
- Results should be reviewed to ensure consistency with other sources of data e.g. against input data and also against boundary conditions such as the value of a property for a fire scenario
- Scenarios should also be crosschecked to ensure they are directionally correct, broadly consistent with each other and that there is no double counting of risks.
- These validation exercises can be done by an independent op risk function and/or audit and/or other central functions and/or by peer review.

An External Loss and Scorecard Based Approach

The 4 Operational Risk principles

- If the world gets **riskier**, the business units need more economic capital
- If a business unit's **size** increases, so does its capital
- If the business of a business unit is more **complex**, it needs more capital
- If the **level of control** of a business unit is lower, it needs more capital

Capital Framework



Key components of operational risk management approach

	Risk management process:	*Risk focus:*	*Risk mgt tool:*
1.	**Operational risk oversight:**	**managed risk**	**ORC committee**
2.	**Earlier detection:**	**undetected risk**	**R&CSA process**
3.	**Understanding risk costs:**	**materialized risk**	**Incidents reporting**
4.	**Tight monitoring:**	**monitored risk**	**KRI reporting**
5.	**Action-tracking:**	**mitigated risk**	**AO Scan tracking**
6.	**Risk management incentives:**	**managed risk**	**Scorecards**

A Methodology For Incorporating Bank-Specific Business Environment and Internal Control Factors

How to incorporate expectations?

- Historic loss data is the foundation. However, historic loss data is not an adequate predictor of future losses, unless there are no changes in the business and control environment
- Historic internal loss data is enriched using external loss data (through benchmarking and scenario analysis)
- Parametric distributions are derived via fitting to empirical loss distribution curves
- Changes in the business and control environment should be captured as part of the methodology -> Control Environment Assessment (CEA)
- Management has the best insight in the current and future situation of its own business -> Statement of Expectations (SoE)

The Statement of Expectations

- The SoE gathers fair estimates of future operational risk loss events to determine:
    - Frequency of Events
        - » Severity of Events

- The SoE is used to determine new parameters for the empirical frequency and severity distributions

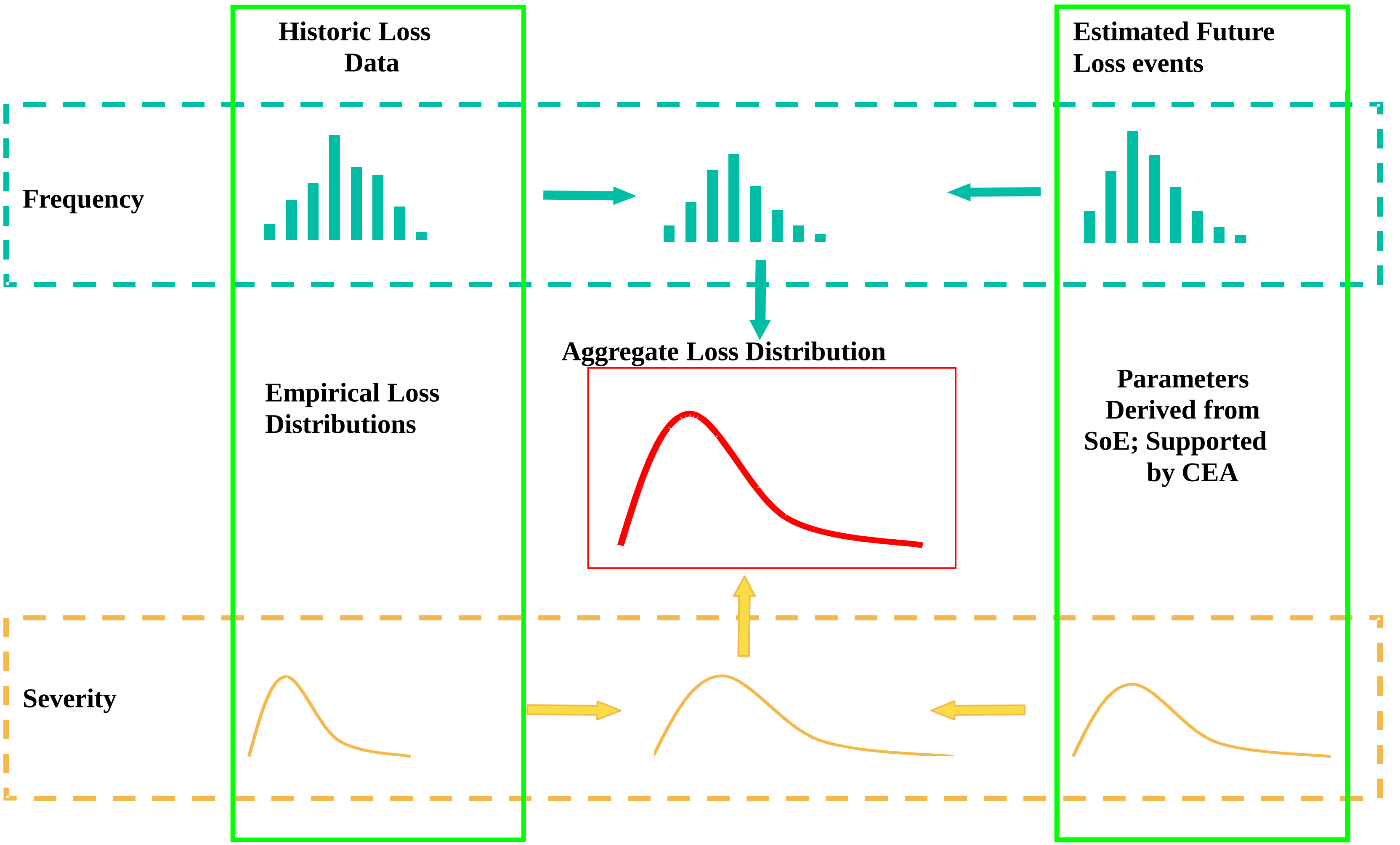
- Management makes these estimates based on the CEA; an assessment of the state and nature of the business and control environment and expected changes therein

The Control Environment Assessment

- The CEA consists of:
  - an analysis of historic loss data (internal and external)
  - an analysis of other operational risk related data (e.g. accounting data, audit data, output of ORM programmes)
  - a trendwatch on the operational risk environment
  - a statement on the level of risk control

- The CEAs will provide management with the necessary insight in the business and control environment to complete

Convolution to Aggregate Loss Distribution



A Bootstrapping Methodology

- An intermediate solution between parametric distribution and non-parametric bootstrapping.

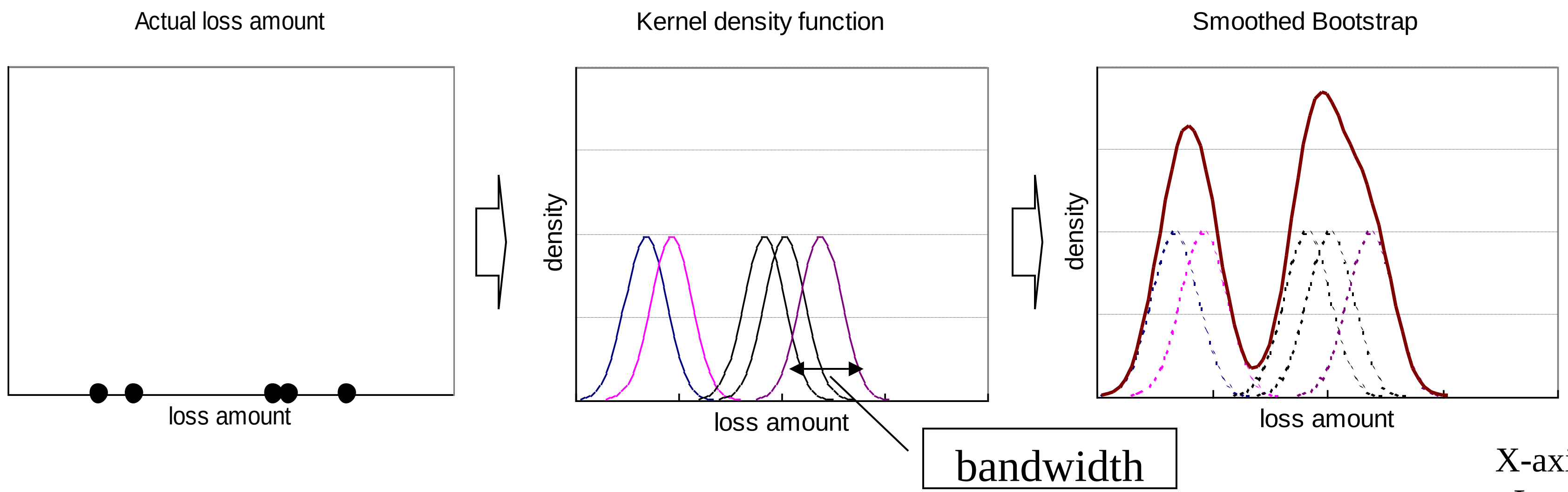
	Description	Strength	Weakness
Parametric	Choosing a distribution and estimating its parameters	Generates a potentially fat tail.	Less powerful when parametric assumptions are not met.
Non-parametric	Sampling from the empirical distribution	No parametric assumption about the distributions and parameters.	Does not generate a potentially fat tail.

Smoothed bootstrap	***Generates a potentially fat tail without any assumptions about distributions.***

- Reflects both
  - Internal loss data for calibrating the main body of the severity distribution, and
  - External loss data or scenarios for calibrating the tail of the severity distribution.

"Smoothed Bootstrap Methodology" (implemented)

- Methodology of smoothing and sampling

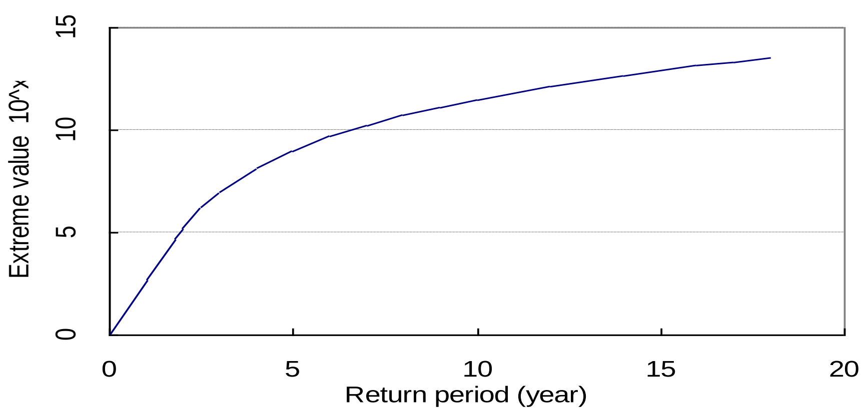


X-axis Log scale

  – Instead of re-sampling directly from the empirical distribution, smooth it first then the smoothed distribution is used to generate new samples. (Monte Carlo method)

- The larger the bandwidth, the fatter the tail of the distribution.

- Once the frequency and severity of the tail events are given by internal data, external data or scenarios, the bandwidth can be determined.
- The frequency and severity of the tail events are described as “Extreme value X during the N-year return period”
  - X is a threshold that is exceeded once per N-year return period on average.
- We get X and N by applying Gumbel distribution.



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Elements of an LDA based AMA approach

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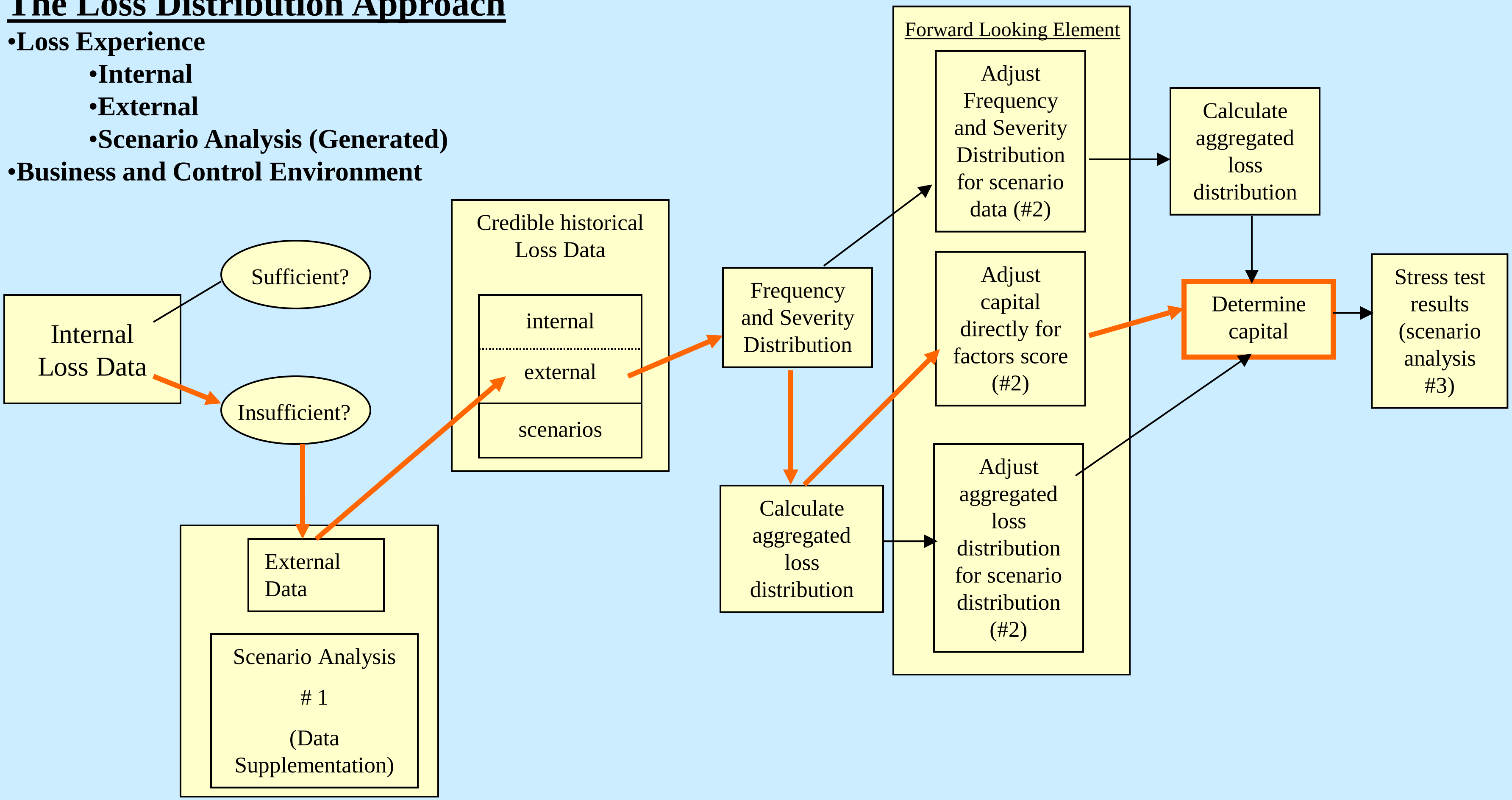

Conclusions

1. ITWG banks are using a variety of methods for determining operational risk capital
   - The variety is in emphasis of various components not in fundamentals

2. ITWG banks use historical losses as the foundation for their AMA

3. A variety of methods have been developed for incorporating the change in the business and control environment ie a forward looking element

4. How confident are we in the results? Sufficiently because they meet the ultimate test of credibility: The results are used by management in running the bank

5. Much progress has been made in the last year and although much more needs to be developed, it is more in the nature of improving rather than invention.

END