Operational risk: The journey so far and way forward

An overview of the challenges faced

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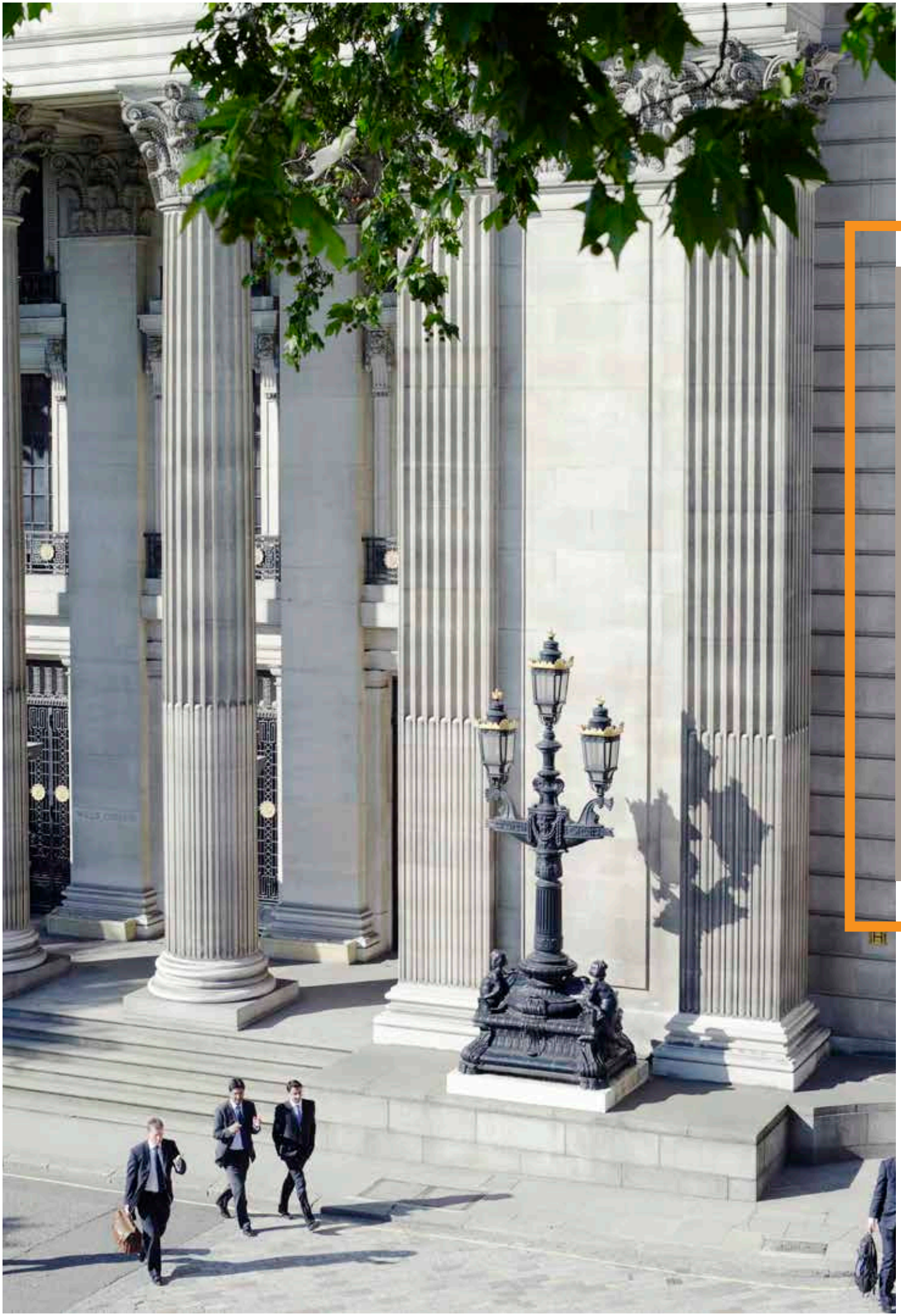


Introduction

The generic term 'operational risk' (OR) was officially used in the Committee of Sponsoring Organizations of the Treadway Commission (COSO) framework (1991), but only began to be widely used after the Basel II proposals were developed and published in June 1999. In retrospect, the rogue trader that cost UBS 2 billion USD and considered responsible for the destruction of Barings Bank in 1995 may be regarded as the true inventor of the concept of OR.

OR is not an abstract concept. Banks, in particular, have been aware of the hazards and uncertainties arising from information technology (IT) infrastructure, internal fraud perpetrated by employees, business disruption, legal liability and similar issues for many years. However, the renewed visibility of these risks under the label of OR repositions their location and status for the purpose of management decision making. The link established by Basel II between the management of OR and good corporate governance is a way to position these old risks in the new space of regulatory, political and social expectations.

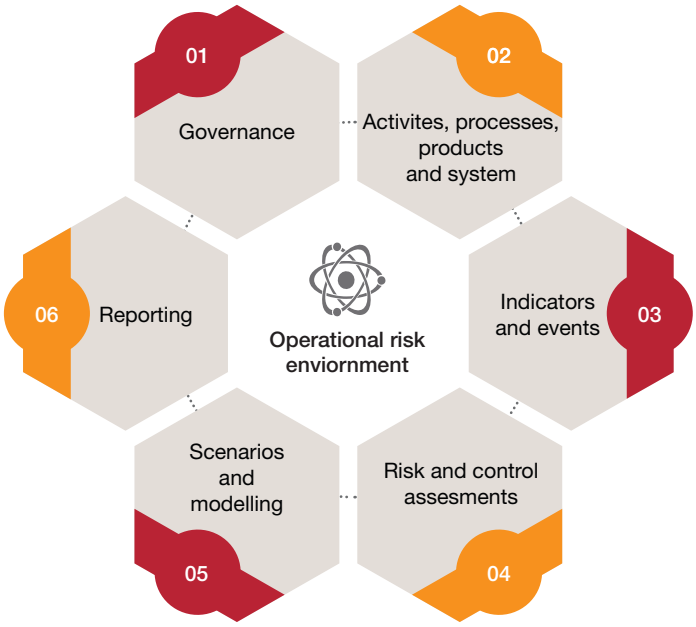
In recent years, OR has become one of the most discussed topics in the financial services industry. The increased attention can be attributed to higher investments in information systems and technology, the increasing wave of mergers and acquisitions, and emergence of new financial instruments.

In addition to a capital requirement for OR, Basel III (or the Third Basel Accord or Basel Standards) has requirements on liquid asset holdings and funding stability, thereby seeking to mitigate the risk of a run on a bank, and further motivates financial institutions to more precisely measure and manage this type of risk.

This document sheds light on the main characteristics of OR, methods to calculate OR like The Standardised approach (TSA) and Advanced Measurement Approach (AMA) and challenges faced in the application of AMA along with our perspectives on how to address such challenges.

[1] Ball, D., Sonne, P. and Mollenkamp, C. (16 September 2011). UBS: Rogue Trader Hit Firm. The Wall Street Journal. Retrieved from https://www.wsj.com/articles/SB10001424053111904060604576571931690088522 (last accessed on 30 May 2018)

Definition



- The most common definition of OR is the 'the risk of loss resulting from inadequate or failed internal processes, people and systems or from external events'.
- This definition includes legal risk, but excludes strategic and reputational risk.
- It can also include other classes of risk, such as fraud, security, privacy protection, legal risks, physical or environmental risks.
- As long as people, systems and processes remain imperfect, OR cannot be fully eliminated.
- OR can nonetheless be managed in order to minimise losses within an acceptable level of risk tolerance determined by balancing the costs of improvement against the expected benefits.

Features of operational risk

Characteristics of ORs	Implications
1. ORs are endogenous, i.e. specific to the facts and circumstances of each company. They are shaped by the technology, processes, organisation, personnel and culture of the company. By contrast, market, credit and insurance risks are driven generally by exogenous factors.	Need to gather firm-specific data. However, most firms do not have a long history of relevant data. In banking, industry-wide data is being gathered, but it may not be necessarily representative at all times.
2. ORs are dynamic, continuously changing with business strategy, processes, technology, competition, etc.	Even a firm's own historical data may not be representative of current and future risks.
3. The most cost-effective strategies for mitigating ORs involve changes to business processes, technology, organisation and personnel.	A modelling approach that can measure the impact of operational decisions is needed. For example, 'how will ORs change if the company starts selling and servicing products over the Internet, or if a key function is outsourced?'

The endogenous and dynamic nature of ORs suggests greater reliance on expert input and professional judgement to fill data gaps. The use of operational strategies to mitigate ORs suggests a causal modelling approach that managers can use to perform what-if analyses as the goal of risk management is to reduce ORs, not just measure them.

Types of operational risk

Basel III projects seven types of ORs that banks and financial institutions should bring into focus:

Internal fraud	• Acts of fraud committed internally in an organisation go against its interest. Examples: Unauthorised transactions resulting in monetary loss, embezzlement of funds, misappropriation of assets, forgery, bribes, deliberate mismarking of positions and theft
External fraud	• External frauds are activities committed by third parties. Examples: Theft, bank robbery, breaches of system security like hacking or acquiring unauthorised information
Employment practices and workplace safety	• Non-compliance with employment or health and safety laws and regulations are grave operational hazards in any organisation. Examples: Employee discrimination issues, inadequate employee health or safety rules
Clients, products and business practice	• Organisations fail to meet promises made to their clients as a result of unintended circumstances arising from negligent practices. Examples: Privacy and fiduciary breaches, misuse of confidential information, suitability issues, market manipulation, unlicensed activities, money laundering
Damage to physical assets	• These are losses incurred by damages caused to physical assets. Examples: Natural disasters or other events like terrorism and vandalism
Business disruption and systems failures	• System failures (hardware or software), disruption in telecommunication, and power failure can all result in interrupted business and financial loss. Example: Blackout
Execution, delivery and process management	• Failure in delivery, transaction or process management is an OR that has the potential to bring losses to a business. Examples: Data entry error, incomplete or missing legal documents, disputes with vendors/outsourcing

Operational risk process

ORs impact the reputation and financial stability of a business significantly. A lack of strong risk mitigation strategies results in various operational failures, leading to crises in organisational management. This is why many businesses have started procuring significant resources to design a more robust risk management framework.

Contemporary businesses are particularly keen to develop business strategies that align with risk evolution. Characteristically, the process begins with the assessment of factors that can give rise to uncertainties. This process also impacts existing and future business objectives.

Organisations need to ensure that effective controls exist at the first, second and third risk evolution stages. The earlier the controls are established in the risk journey, the more effective the risk detection and mitigation mechanism will be. Predominantly, ORs are best discovered, controlled and mitigated using a seven-step approach. It supports multiple facets and has the ability to alleviate numerous risks concurrently.

1 Governance

Developing concise and yet unique operational risk policies, frameworks, terms of reference and timelines consistent with an organisation's risk appetite and risk culture

2 Risk and control assessment

Identifying the gross risks to which an organisation is subject and then scoring risks and identifying and scoring the relevant controls

3 Losses

Analysis of a loss is an invaluable challenge and includes validation of subjective risk ,control assessment identification and scoring of the losses

4 Key risk indicators (KRIs)

Identification, capture and analysis of the metrics of key risks (and controls), leading to the validation of the risk and control assessments

5 Modelling

Using different BASEL-compliant models to calculate an organisation's capital requirement

6 Reporting

Reporting of the OR exposure in the form of coherent reports to enable decisions to be made regarding an organisation's risk exposure

Approaches for calculating operational risk capital

The management and measurement of OR have been a key regulatory focus historically given the number of significant loss incidents which banks have failed to prevent or hold sufficient capital against. Significant policy changes or consultations regarding OR modelling have resulted into lot of regulatory events as indicated below.

1

BASEL II (June 2004)

Set out the framework of the three approaches to modelling the minimum capital requirements for operational risk (Basic Indicator Approach [BIA], TSA and AMA), introducing an increasing level of sophistication and risk sensitivity

2

Basel Committee on Banking Supervision Supervisory Guidelines for AMA (June 2011)

Provided clearer supervisory guidance relating to governance, data and modelling to assist the maturity of an AMA organisation's operational risk management and measurement approaches

3

BCBS Revisions to the Simpler Approaches (October 2014)

Introduced the revised standardised approach aimed at simplifying BIA and TSA to allow more comparability between organisations using the approach and give a more accurate reflection of the OR inherent within a bank

4

EBA Regulatory Technical Standards – use of AMA (June 2015)

Enhanced regulatory harmonisation in the banking sector across the EU by establishing common standards for the assessment methodlogy for all AMA-approved banks

5

BCBS Standardised Measurement Approach (March 2016)

Introduced the standardised measurement approach (SMA) aimed at building on the simplicity and consistency offered by the standardised approach as well improving risk sensitivity by incorporating internal loss data

Historically, there are two broad approaches: 1) top-down approach and 2) bottom-up approach.

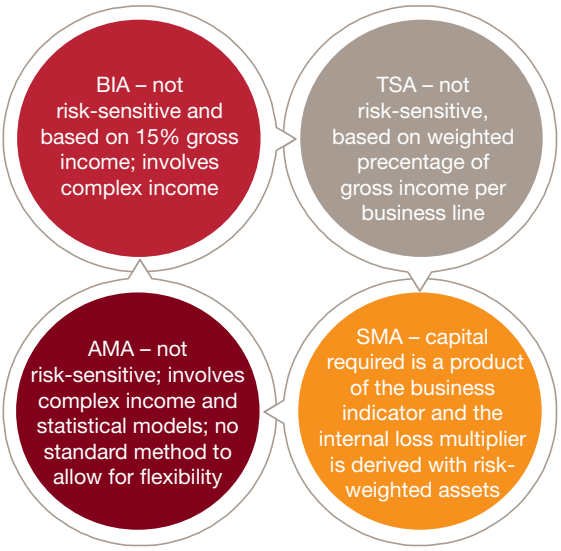
- **Top-down approaches:** This approach is convenient but insufficient for risk managers who seek to mitigate or prevent severe operational losses. They analyse OR at the firm level. A top-down approach may be employed by an external debt or equity analyst with publicly available data, but it is too superficial as it does not require clarity into the firm's specific operations.
- **Bottom-up approaches:** This approaches is relevant to a risk manager whose job includes the control, mitigation, prevention and cost/benefit or optimisation of ORs. Bottom-up approaches can be further bifurcated into:
  - **Process approaches:** While they are not mutually exclusive (as process approach outputs can be actuarial inputs), process approaches include scorecards and event trees.
  - **Actuarial approaches:** They use the leading methods for modelling OR. Actuarial approaches need people and are dependent on processes, but they cannot be implemented without quantifiable data. Loss Distribution Approaches (LDAs) are common in sophisticated practice and are used to meet the qualifying criteria under Basel's internal advance measurement approach.

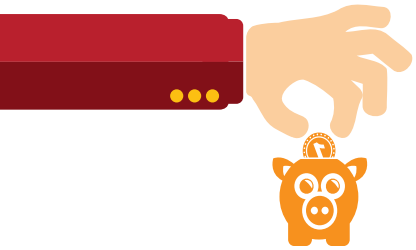
Current methods for calculating operational risk

There are three existing approaches—Basic Indicator Approach (BIA), the Standardised Approach (TSA) and Advanced Measurement Approach (AMA). In 2016, standardised measurement approach (SMA) was introduced to assess OR as a replacement for all existing approaches, including internal models. The Standardised Measurement Approach (SMA) introduces increasing levels of sophistication and risk sensitivity. Internationally active banks and banks with significant OR exposures were expected to use an approach that is more sophisticated and that is appropriate to the risk profile of the institution. Banks were encouraged to move along the spectrum of available approaches.

BIA

- Under the BIA, banks are required to hold capital for OR equal to 15% of the three-year average of positive gross income
- The relevant indicator is the three-year average of the sum of:
  - a firm's net interest income; and
  - a firm's net non-interest income.
- The three-year average must be calculated on the basis of the last three yearly observations at the end of the financial year. When audited figures are not available, business estimates may be used.
- If for any given observation, the sum of a firm's net interest income and net non-interest income is negative or equal to zero, this figure must be excluded from both the numerator and denominator when calculating the three-year average.
- The relevant indicator must be calculated as the sum of the positive figures divided by the number of positive figures.





TSA

- The TSA is simply an extension of the BIA that allows banks to divide their activities into eight business lines and apply a weight to each of these business lines.
- The capital charge for each business line is calculated by multiplying gross income by a factor assigned to that business line. The factor (known as the beta factor) ranges from 12% to 18% depending on the business line.
- A negative gross income for a business line may be included, but a total GI for any given year that is negative must be set to zero.
- The total capital charge is calculated as the three-year average of the simple summation of the regulatory capital charges across each of the business lines in each year.
- In any given year, negative capital charges (resulting from negative gross income) in any business line may offset positive capital charges in other business lines without limit.

Regulatory prerequisites for using the TSA:

- The board of directors and senior management, as appropriate, are actively involved in the oversight of the OR management framework.
- The bank has an OR management system that is conceptually sound and is implemented with integrity.
- It has sufficient resources for the adoption of the approach in the major business lines as well as the control and audit areas.

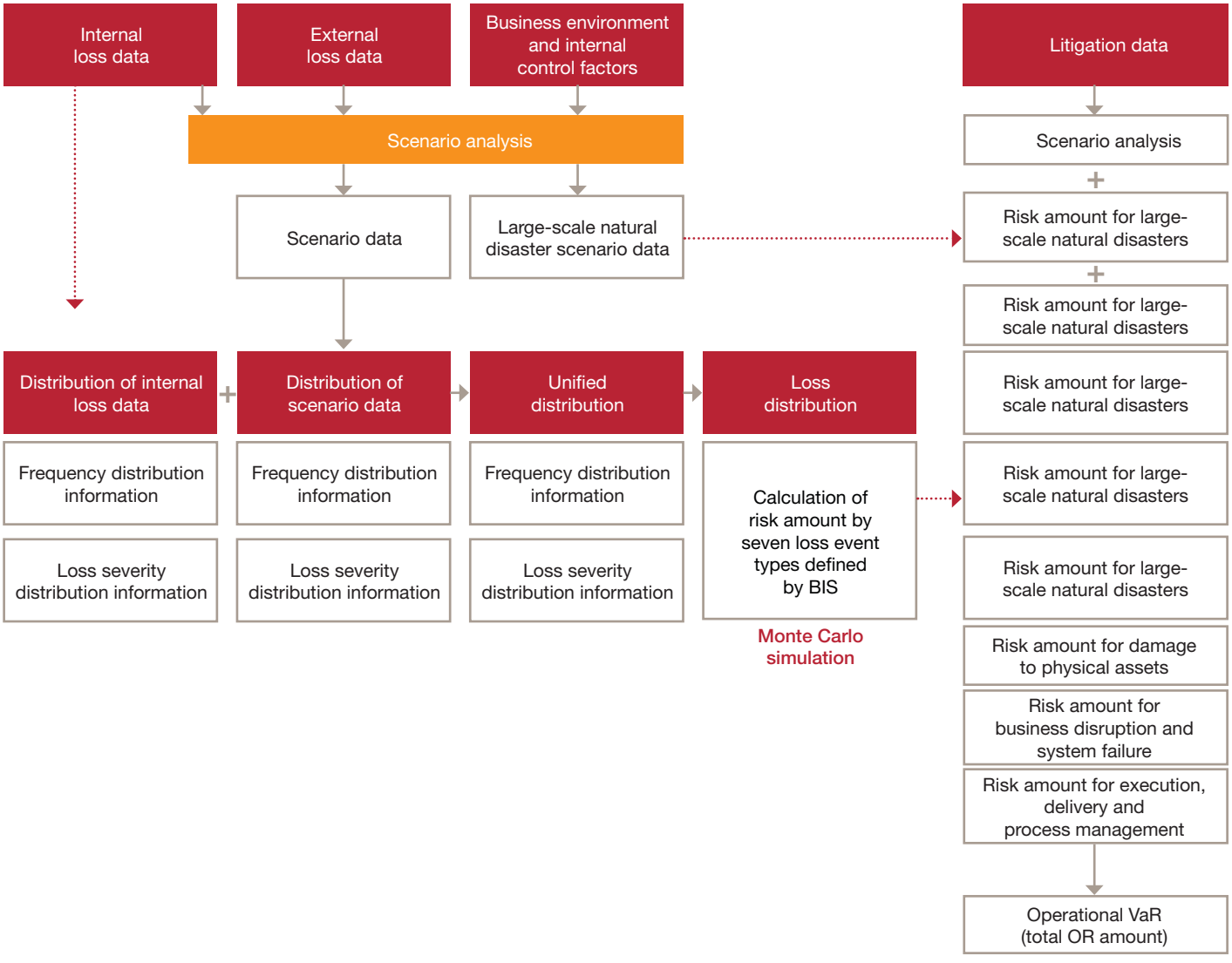
Business line	Beta factor
Corporate finance	18%
Trading and sales	18%
Retail banking	12%
Commercial banking	15%
Payment and settlement	18%
Agency services	15%
Asset management	12%
Retail brokerage	12%

If the bank is internationally active, then the following additional criteria must be met:

- Responsibilities within the OR management system must be assigned to an OR management function.
- The bank must systematically track relevant OR data by the business line.
- OR exposures must be regularly reported to business unit management, senior management and to the board of directors.
- Further, the bank must have procedures in place for taking appropriate actions.
- The OR management system must be well documented.
- The OR management processes must be subject to validation and regular independent review.
- The OR assessment system must be regularly reviewed by external auditors or supervisors.

AMA

- Under AMA, the banks are allowed to develop their own empirical model to quantify the required capital for OR. With the AMA, the regulatory capital is determined by a bank's own internal OR measurement system according to a number of quantitative and qualitative criteria set forth by the Basel III Committee.
- Banks can use this approach only subject to approval from their local regulators.
- Once a bank has approval to adopt the AMA, it cannot revert to a simpler approach without supervisory approval.
- The AMA is based on the collection of loss data for each event type. Each bank is to measure the required capital based on its own loss data using the holding period and confidence interval determined by the regulators (1 year and 99.9%).
- The capital charge calculated under the AMA is initially subjected to a floor set at 75% of that under the TSA, at least until the development of measurement methodologies is examined.
- A bank intending to use the AMA should demonstrate the accuracy of the internal models within the Basel III risk cells (8 business lines × 7 risk types) relevant to the bank and satisfy the following criteria:
  - The use of internal data, relevant external data, scenario analyses and factors reflecting the business environment and internal control systems;
  - Scenario analyses of expert opinion;
  - The risk measure used for capital charge should correspond to a 99.9% confidence level for a one-year holding period;
  - Diversification benefits are allowed if dependence modelling is approved by a regulator;
  - Capital reduction due to insurance is fixed at 20%. The relative weight of each source and the combination of sources is decided by the banks themselves; Basel III does not provide a regulatory model.



Components of the AMA data model:

According to the BCBS 196 Supervisory Guidelines, an AMA framework must use four data elements:

A. Internal loss data (ILD),
B. External loss data (ELD),
C. Scenario analysis, and
D. Business environment and internal control factor (BEIC).

ILD

- Losses arising from OR events occuring in an organisation
- Collected via an internal loss reporting process above a certain threshold

ELD

- Losses from OR events occuring in other organisations
- Collected by external providers or consortiums

The bank has to demonstrate that it has appropriate internal and external loss event data, assessments of business enviornment and internal control factors, and results from scenario analysis to support an OR management and measurement framework.

Scenario analysis

- Potential OR events that could occur in an organisation based on business expertise
- Collected via a faciliated workshop

BECIF

- A collection of risks and controls based on an organisation's processes
- A collection of key indicators that aim to proactively identify potential areas of risk

A. Internal loss data (ILD)

1

Documentation

Under the AMA, a bank must have documented procedures for assessing the ongoing relevance of historical loss data, e.g. for scaling historical data and about who is authorised to make the corresponding decisions.

2

Period

The internal data should be collected over a minimum five-year period to be used for capital charge calculations (when the bank starts the AMA, a three-year period is acceptable).

3

Risk events

A bank must be able to map its historical ILD into the relevant Basel III risk cells. The data must capture all material activities and exposures from all appropriate sub-systems and geographic locations.

4

Value of ILD

The collection of ILD assisted banks in identifying, measuring and monitoring their OR exposures. Banks used ILD to identify emerging trends in their loss profile and to alert managers to areas where action is required.

5

Threshold

The data collection threshold can differ from the data modelling threshold. Banks' collection thresholds have ranged from 1 USD to 20,000 USD; and the modelling thresholds extend to 1,00,000 USD.

6

Loss amounts

- Gross loss: All applicants must capture the gross loss amount, with a separate field for insurance and non-insurance recoveries.
- Near miss:The collection of near-miss events is not required; however, many banks incorporated them in their risk management and measurement systems.
- Rapid recoveries: The amount mistakenly transferred to professional market counterparties may be recovered with a high degree of certainty and within a short time period. It is not taken into consideration for capital measurement purpose.

7

Capturing dates

A bank should collect information about the date of the event, any recoveries of gross loss amounts, as well as some descriptive information about the drivers of the loss event.

8

Data collection

Dates, various amounts, event types, legal entity, country, recoveries, insurance, descriptions, ledgers, etc.

Incorporating ILD in AMA

- Most banks fitted a statistical distribution to their ILD. This was largely focused on the high frequency–low impact area of the distribution, where the quantum of data is sufficient. Some banks used an empirical distribution, rather than a parametric distribution.
- ILD feeds into key risk indicators (KRIs) and other business environment and internal control factors (BEICFs), which are used by banks for both measurement and management purposes.
- Most banks use ILD as a reference source to inform the scenario assessors of relevant historical events in their scenario analysis workshops. Banks also used ILD to allocate total OR capital to individual business lines.

Challenges typically faced by banks

B. External loss data (ELD)

The value of ELD contributes for benchmarking and for performing and informing OR scenarios. ELD data also helps to estimate the tail parameters of an OR. External data provides valuable information about the losses experienced by other businesses, and it assists a bank in quantifying its exposure to risk events that have not been experienced internally.

Sources of external data		
Publicly available data	**Consortium data**	**Insurance data**
Public databases generally only contain very large losses which are likely to attract the attention of the media. Some risk types (e.g. fraud) are more likely to attract attention than others (e.g. execution, delivery and process management). The loss amounts published are unlikely to be accurate, since they may not include all of the costs associated with the event, and they are typically subject to rounding. However, public data is desirable since it discloses the identity of the bank that suffered the loss, which is useful for scaling purposes.	Consortium facilitators compile non-public data from member institutions and provide anonymous statistical analysis and basic loss information. To ensure the anonymity of the consortium members, all identifying information is removed from each loss, making any meaningful analysis and scaling of the data difficult.	Provided by insurance brokers, the data originates from OR-related insurance claims. The risk types and severity ranges likely to be included in insurance data depend on the types of policies taken by the banks and the policy deductibles. The data will cover only those risk types which are insurable.

Incorporating ELD in AMA

- Banks developed selection criteria to filter ELD for losses that are relevant to their OR profile.
- Some banks fitted a parametric distribution to the relevant ELD, and some used the data empirically. Banks used scaled data, rather than raw data.
- Most banks used ELD as a reference source in their scenario analysis workshops, to provide insight into the types of events that they are exposed to, and the frequency and severity of an event type.
- Most banks experienced difficulty finding relevant ELD for their scenarios.

Challenges typically faced by banks

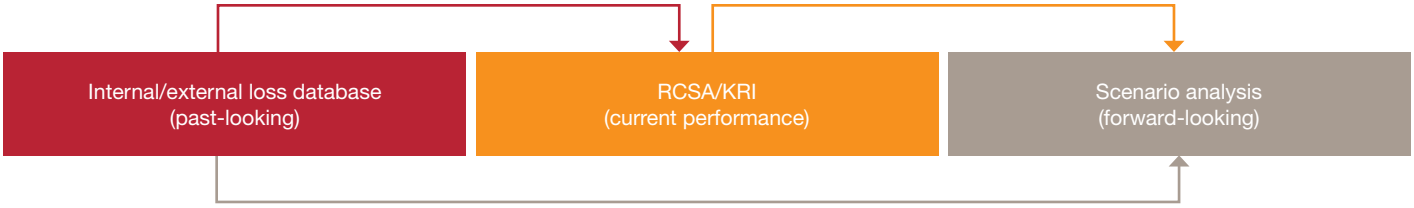
C. Scenario analysis

- Scenario analysis typically involves the examination of rare, significant, yet plausible future events, taking into consideration the alternative possible outcomes for those events, and assigning probabilities to the various scenarios.
- The range of practice has varied by the workshop structure, content and the wording of questions asked of participants.
- The level of understanding of scenario workshop participants has varied, both within and between applicants.
- This has largely depended on the wording of the questions asked, the training given prior to or during the workshops, and the level of guidance and challenge provided by the group OR function.
- Scenario analysis provides an important link between the measurement and management of OR.
- This benefit has been particularly strong where scenario analysis results are used to determine the capital allocation to business units.
- A challenge arises since there is an opportunity for managers to game the capital number by deliberately undervaluing scenario assessments for their business unit.
- A challenge process is used to ensure that the assessments are valued appropriately.
- Scenario analysis is defined as the forecast of operational losses and events that cause them, based on the knowledge of business experts.
- The primary set of issues related to scenario analysis is the inherently subjective nature of the process.
- However, some techniques have been identified to attempt to reduce the subjectivity and increase the repeatability.
- In the process of scenario analysis, scenario data is created as numerical values of occurrence frequency and loss severity reflecting ELD and BEICFs, in order to estimate unexperienced potential future OR events (of low frequency and high severity).
- As for ELD, we refer to data publicly reported by domestic and overseas media, and this data is reflected in the estimation of occurrence frequency and loss severity distribution in the process of scenario analysis.
- We categorise scenario analysis into four approaches in accordance with the characteristics of each loss event type and risk management structures

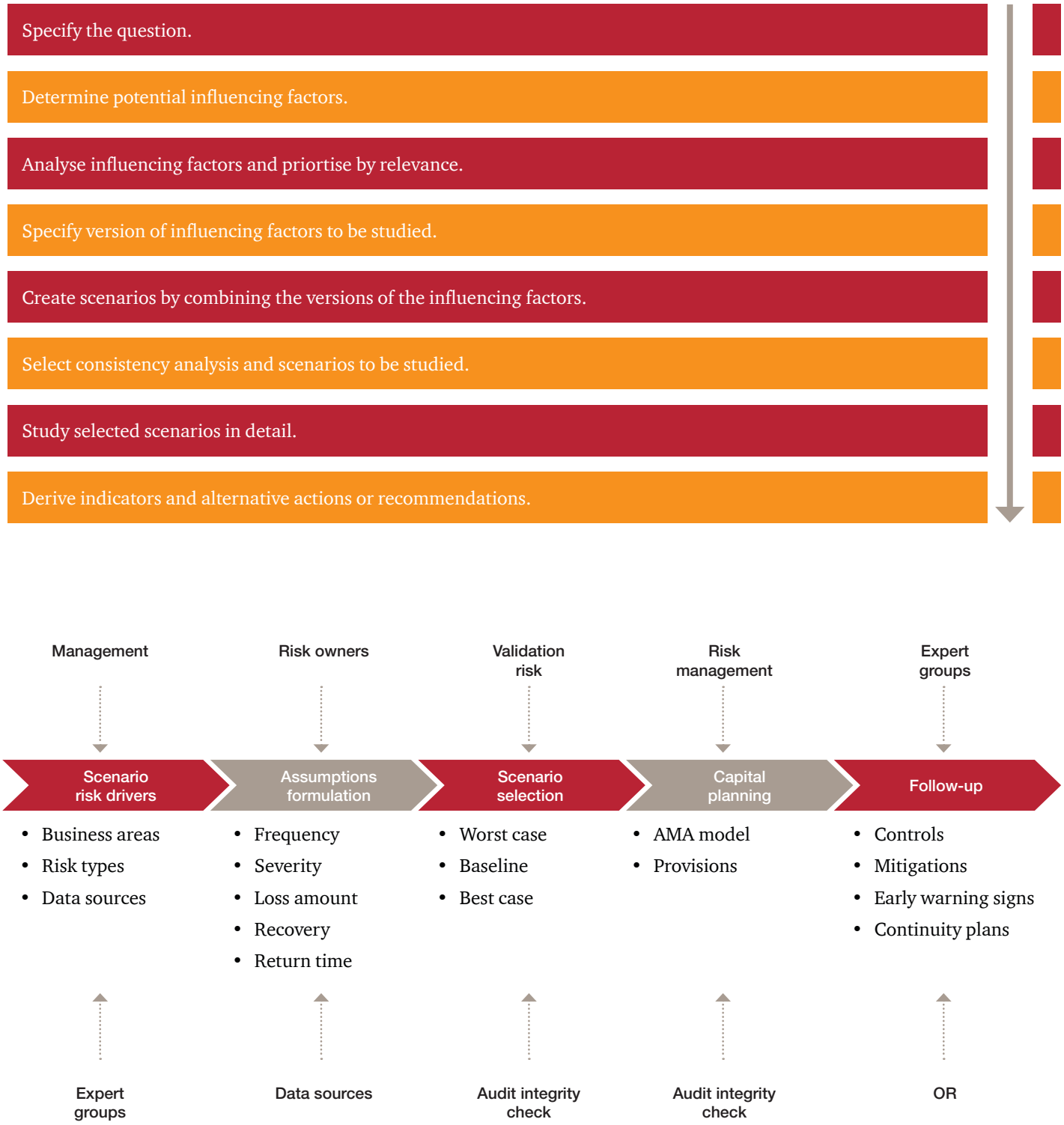
Approach	Loss event types to be applied
A	Internal fraud/external fraud/customers, products and business practices/execution, delivery and process management
B	Employment practices and workplace safety
C	Damage to physical assets
D	Business disruption and system failure

Incorporating scenario analysis in AMA

- Most banks used the results from scenario analysis to parameterise their OR distribution.
- Some banks went further and elicited information to select the type of distribution assigned to each risk.
- Scenarios were also used indirectly to stress test the ability of the capital to withstand extreme events or conditions.
- Banks compared their capital to individual scenarios, and considered cases where two extreme scenarios occurred simultaneously.
- Scenario data provides a forward-looking view of potential OR exposures based on historical or judgmental estimations.



Scenario analysis procedure



Scenario assessment biases

- **Human limitations –** Limitations in the ability to process data and information can often lead to assessments that are poorly calibrated or internally inconsistent.
- **Availability –** Assessments depend on our memory, or our ability to imagine an unfamiliar scenario.
- **Anchoring –** This can occur if workshop participants are presented with internal or ELD that they then use to anchor their assessments.
- **Partition dependence and granularity –** Dividing the set of possible outcomes into 'buckets' or ranges can potentially increase the level of uncertainty in the estimate. If the ranges are too narrow, the subject may be unable to decide which band to choose; if it is too wide, they may feel that their answer is uninformative.
- **Motivational bias –** Managers may an incentive to understate potential losses in order to reduce the capital that is allocated to their business unit. They may feel uncomfortable making scenario assessments at extreme percentiles, and may become defensive when asked to consider the fallibility of their controls.

Challenges typically faced by banks

D. BEICFs

- The business environment consists of the internal and external circumstances of a firm's businesses that can materially affect its OR profile. This includes:
  - The quality and availability of the firm's people, vendors, and other resources;
  - The complexity and riskiness of the businesses, the products they deliver and the processes they use to deliver them;
  - The degree of automation of the product process and the firm's capacity for automation;
  - The legal and regulatory environment for the businesses; and
  - The evolution of the firm's markets, including the diversity and sophistication of its customers and counterparties, the liquidity of capital markets it trades in, and the reliability of the infrastructure that supports those markets.
  - Internal controls are the detective and preventive processes the firm has in place to reduce the frequency or severity of OR losses, or to eliminate altogether the chance of OR events.
  - Controls operate by reducing the exposures created by the business environment, by detecting causes, by preventing specific individual risks from arising and by mitigating their effects when they do arise.
  - They can be specific, like the confirmation process after a trade or the due diligence before a new hire, or general, like a risk and control self-assessment process used to detect and assess risks.
  - They can be manual, like the supervisory end-of-day review of a trader's tickets; partially automatic, like the sign-off often required at certain steps in loan processing by software before the process can proceed; or fully automatic, like many software and building access controls.
- Although past losses are an indicator of future losses, loss data is excluded from factors in the context of capital estimation to avoid double counting, because that data is always taken into account in the other three elements which are internal loss data, external loss data and scenario analysis.
- Apart from above, many kinds of objective and subjective measures can be used as factors, including measures of business expansion such as:
  - numbers of new products and increases in gross and net revenues;
  - the number of customer complaints;
  - the number of audit points and other measures tracking regulatory and policy compliance and progress in closing any gaps in existing practices;
  - outputs from risk and control self-assessments, including indicators reflecting the emergence of new risks, the effectiveness of existing controls, control gaps, and progress in closing them; and
  - Other risk indicators, including general indicators like staff turnover and others specific to human resources.

BEICF characteristics

Key risk indicators (KRIs)

BEICFs can be used to construct KRIs which can measure the level of, and changes in, the bank's OR profile. KRIs can be leading or lagging, and banks should use a balance of both types of indicators. The timely use of leading indicators can provide an early warning signal for trouble ahead, allowing management to act appropriately and avoid potential losses. While this opportunity is ideal, the development of predictive (leading) KRIs remains a challenge for some banks.

Capturing BEICF data

The data required to measure BEICFs includes both objective data, such as revenue or staff turnover, and subjective data, such as the level of complexity or the pace of change.

Key considerations

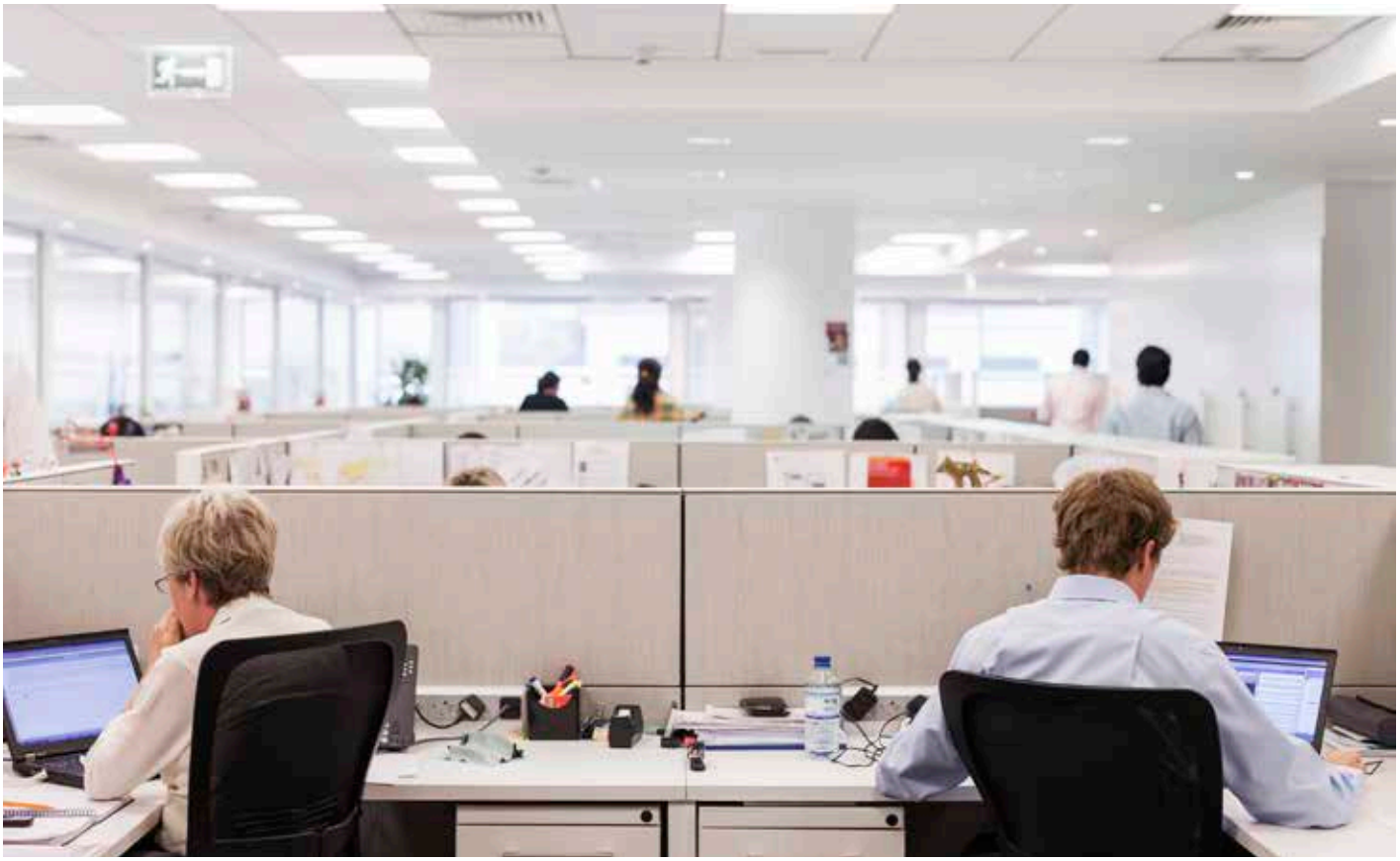
- Which BEICFs drive the OR profile?
- Does a BEICF influence the frequency or severity of a risk exposure, or both?
- Is the relationship between a BEICF and a risk exposure linear or non-linear?
- Could that relationship change over time?

Using scorecards to measure BEICFs

- The effectiveness of this method depends on how the response scale is constructed and the recognition of biases in the respondents' answers.
- Respondents' scoring may exhibit a number of biases, including:
  - Leniency: Tendency to rate too high or too low, i.e. to rate in an extreme way
  - Central tendency: A reluctance to give extreme scores
  - Proximity: Similar responses to items that occur close to one another

Constructing scales

- Banks must choose the number of points on the scale. A highly granular scale (lots of points) can introduce spurious accuracy, while a sparse scale (too few points) may fail to capture information precisely. For some types of scales, an odd number of points can be used to provide a middle or neutral option, whereas an even number of points will force a decision either way.
- Banks' scales range from three points to nine points, with a mixture of odd- and even-numbered scales being used.



Incorporating BEICFs in AMA

- **Direct modelling:** Some banks used BEICFs to quantify their risk exposures. The results are used to set parameters for the statistical distributions used to calculate OR capital.
- **Consideration in scenario analysis:** Most banks considered BEICFs in their scenario analysis process. BEICFs can assist scenario assessors in tailoring their estimates to reflect the current risk profile. Scenario assessments of frequency and severity should be adjusted to reflect changes in BEICFs, with supporting documentation explaining the rationale behind the changes.
- **Allocation mechanisms:** Some banks used BEICFs to allocate group OR capital for business units. The intention is that the business units hold capital commensurate with their residual risk profile. Allocations are typically calculated using scorecards. The banks' group OR functions play a role in checking for consistency in interpretation of the scorecard across business units.
- **Interim adjustments:** BEICFs were used by banks to update the capital estimate, reflecting changes in the risk profile that occur between the annual formal capital calculations.

Challenges typically faced by banks

Six key attributes of the AMA model

Depending on a bank's nature, size and complexity, and the risk profile of its activities, the degree of the relevancy of the key model attributes will vary. The outputs of OR models are important for a robust OR framework.

Uses a stable and simple quantification approach	Simplify the methods required by using a lower confidence level given that the 1 in 1,000 years benchmark under the AMA has proved impractical	Reduces model uncertainty given the better alignment between the available historical data and the confidence interval of the estimation, and supports P&L projection – a key aspects of stress testing
Provides reasonable accuracy of estimates	Improve modelling techniques without AMA restrictions	Improves model accuracy and allows to better leverage techniques to confirm the predictive accuracy of models such as backtesting
Contains an exposure measure of risk	Bring OR measurement into line with financial risk modelling where the exposed unit has long been central to determining the potential impact of risk	Makes models dynamic and responsive to changes in business profile and growth; facilitates 'what if' analysis for business decisions
Includes drivers of risk	Identify key drivers of risk and connect these drivers to their frequency and exposure of impact	Allows for one model to produce unconditional and conditional estimates of risk – can fully integrate with stress testing
Recognises risk mitigation	Reflect the benefit of the controls in place, insurance cover and other key existing risk mitigant techniques in place.	Facilitates business decisions on the trade-off between cost and risk, e.g. helps optimise insurance cover
Facilitates capital allocation	Allow for OR allocation to different business lines based on key risk drivers	Allows for informed measurement of risk/return trade-offs

Loss Distribution Approach (LDA) based AMA

- LDA is based on the assumption that there is a fixed and stable relationship (linear or non-linear) between expected and unexpected losses.
- In a linear relationship, the capital charge is a simple multiple of expected losses, whereas in a non-linear relationship, the capital charge is a complex function of expected losses.
- Overall distribution of losses is derived from the frequency and severity distribution for each business line/risk-type cell over some future horizon (generally, one year).
- The resulting capital charge is based on a very high percentage of the loss distribution.
- LDA is a statistical approach for computing aggregate loss distributions.
- Under the LDA, banks quantify distributions for frequency and severity of OR losses for each risk business line/event type over a one-year horizon.
- Banks can use their own risk business lines but must be able to map the losses to the Basel II risk business lines.
- Under the LDA, the bank estimates, for each business line, the probability distribution functions of the single event impact and the event frequency for the next (one) year using its internal data, and computes the probability distribution function of the cumulative operational loss.
- The LDA has been extensively used in the recent literature for modelling risk.
- It presents a practical approach to modelling risks for which a large amount of objective external quantitative experience data is readily available (typically financial and insurance risks).
- The estimated loss distribution combines the loss frequency distribution and the loss severity distribution.
- The Poisson and negative binomials are usually proposed as models for frequency of losses and the Generalized Pareto distribution is proposed to measure the severity of losses.
- Monte-Carlo simulation is often used to perform the convolution of both frequency and severity distribution in order to find the aggregate loss distribution over a specified period of time.
- Value at risk (VaR) is often used as a risk metric to assess the need for capital to cover risk for each risk category and line of business.
- Risk capital is often estimated by the sum of these VaRs. The correlation between losses is often modelled using a simple copula. A normal or t-copula is often the most popular candidate.

Under the LDA, banks must segment their loss data to obtain datasets that are not demonstrably heterogeneous.

- These datasets are referred to as units of measure or UOMs.
- These datasets are used for subsequent modelling within the LDA.

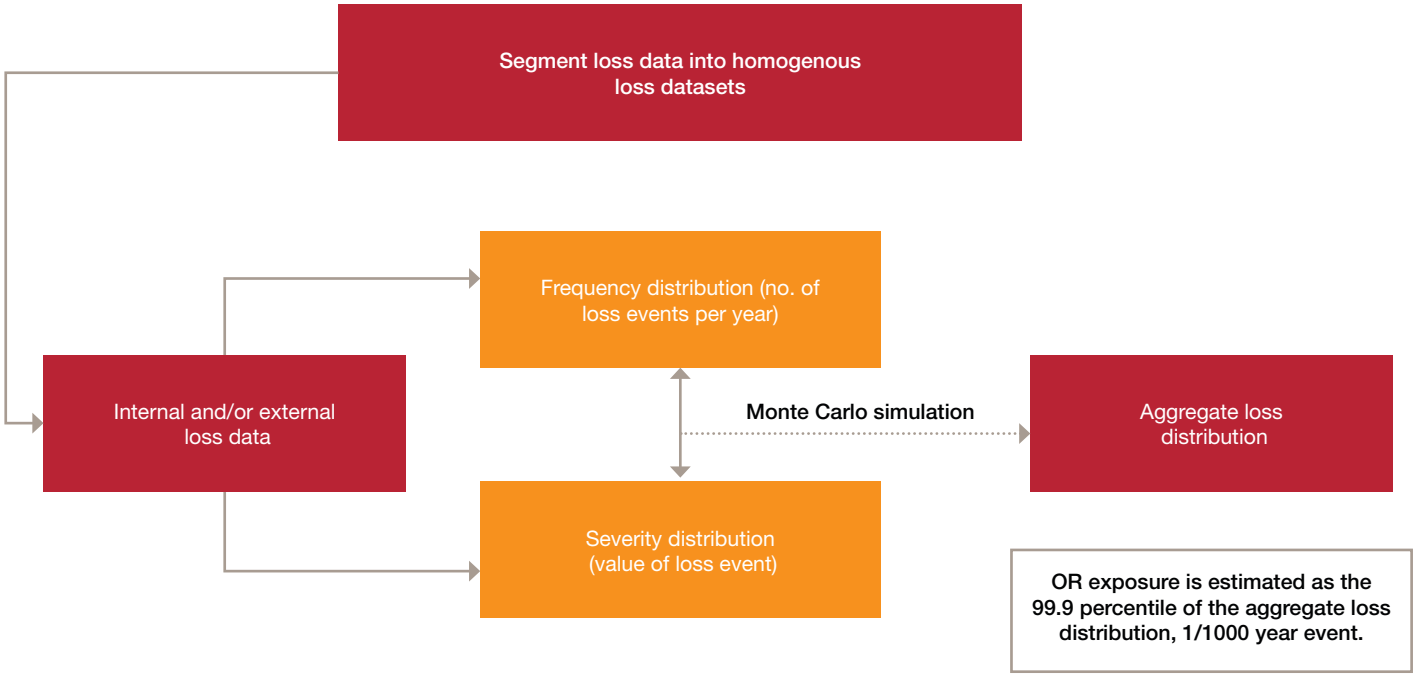
The LDA models two primary componets of operational loss data

- **Loss frequency:** The banking industry had widely accepted a Poisson distribution as an appropriate distribution.
- **Loss severity:** Fitting a parametric distribution to operational loss data is one of the biggest challenges in measuring operational risk exposure.

Monte Carlo simulation is then utilised to compound the two distributions:

- A large number of simulations must be run to observe a sufficient number of losses to reasonably assess what a 1 in 1000 year event might look like.
- Banks typically sum the VaR estimates for their UOMs and perform diversification modelling to move away from the assumption of positive correlation

Loss distribution approach



SMA

In March 2016, the Basel Committee on Banking Supervision (BCBS #355) published a new consultative paper on SMA for the estimation of OR regulatory capital. The new SMA is intended to replace all three existing approaches (BIA, STA and AMA).

The committee wants to make capital requirements comparable for OR by defining a consistent measurement for all banks. The new SMA is in line with the standardisation and homogenisation in the context of Basel IV. In particular, the high degree of freedom, currently implied in AMA, shall be reduced. Nevertheless, the measurement for OR is said to be bank-specific and the simplicity of current standardised approaches shall be preserved.

With the proposed SMA, banks with more effective risk management and low OR losses are required to hold a comparatively lower OR regulatory capital. This approach combines the BIA with a bank's ILD (for medium and large banks). It improves risk sensitivity and provides an incentive for banks to improve their OR management. To calculate the OR capital requirement, the BCBS has proposed a standardised formula, with the business indicator (BI) and loss component being the two key elements.

Calculation of SMA

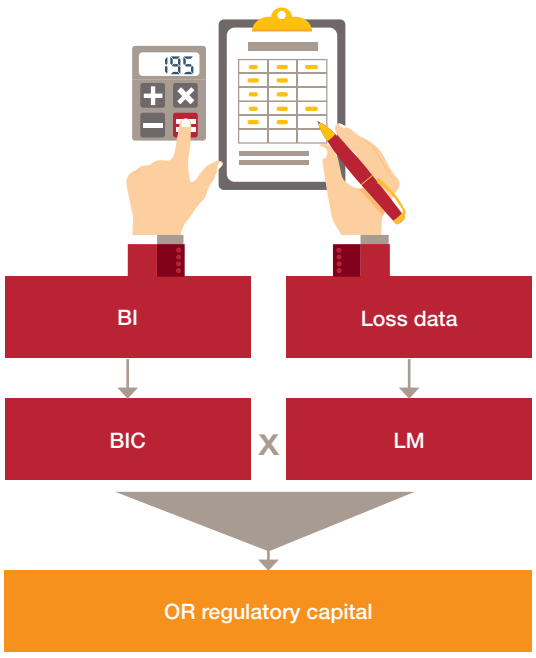
Two components are multiplied with each other in order to calculate OR capital requirements:

1. Business indicator component (BIC)
2. Loss multiplier (LM)

The BIC is derived from the BI. The LM is based on observed historical bank-specific operational losses. Banks of bucket 1 (BI up to 1 billion EUR) calculate OR regulatory capital solely by the BIC (the LM is assumed to be 1). The capital requirements for banks of buckets 2 to 5 are calculated by multiplying the BIC and LM. The figure below shows the calculation logic:

BI and BIC

- The BI replaces the current variable gross income used in the simple BIA and TSA.
- Three components that are calculated from the profit and loss (P&L) positions as well as balance sheet positions are added up to the BI:
  - Interest, lease and dividend component
  - Services component
  - Financial component
- Under the SMA, banks are divided into five buckets according to the size of their BI (as shown in the table on the next page).
- Size categories (buckets) for the BI are derived by a spillover logic. A weight is assigned to each bucketand the weight increases with each bucket.
- The BIC itself is the weighted sum of the BI buckets.
- For banks in bucket 1, capital is an increasing linear function of the BI and does not depend on internal losses. For banks in buckets 2 to 5, capital is calculated in two steps:
  - Calculate a baseline level of capital using the BI component.



– The portion of the BI component above the threshold separating buckets 1 and 2 is multiplied up or down by a function that depends on the banks' internal losses, to differentiate between banks with different risk profiles.

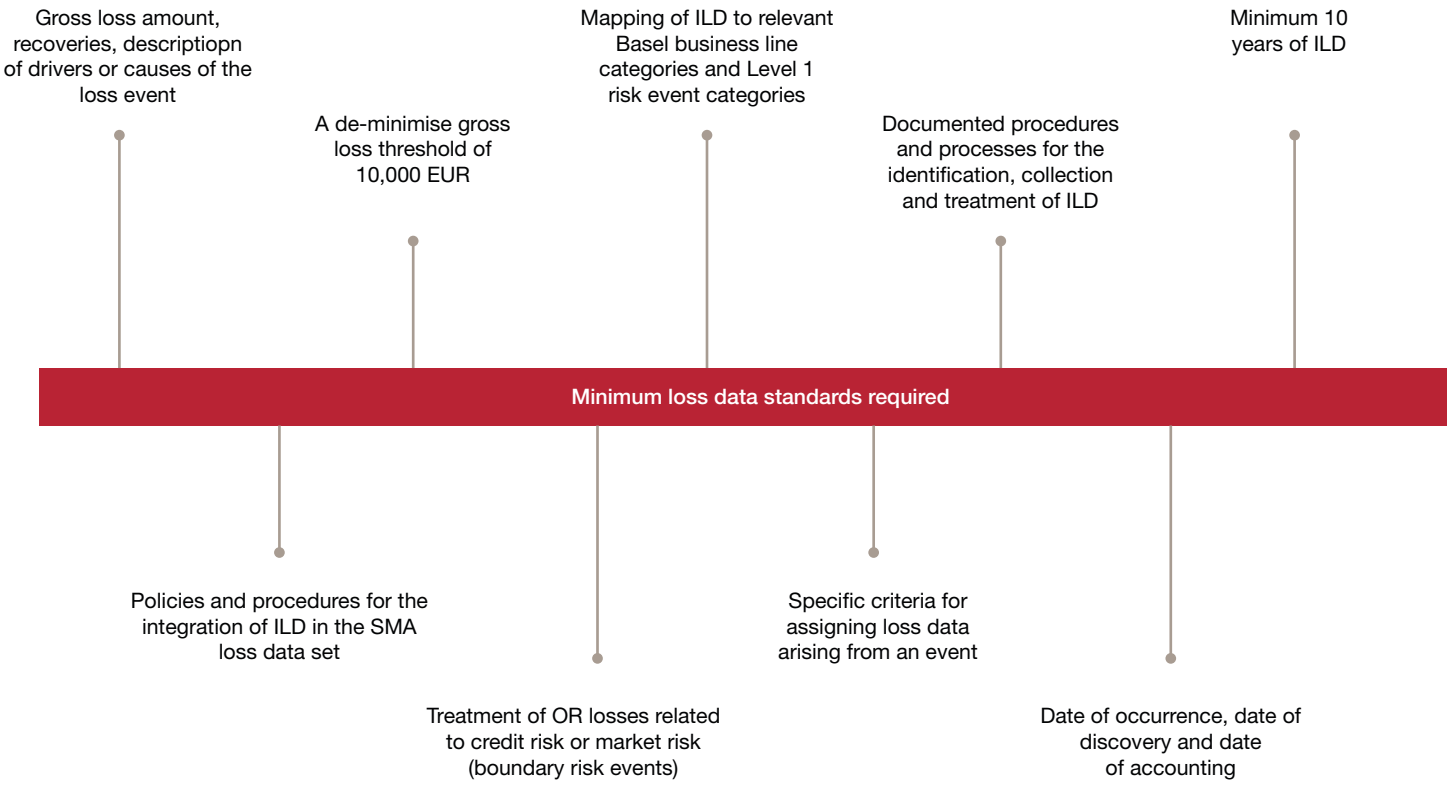
Bucket	BI range (in billion EUR)	BI component
1	0–1	0.11*BI
2	1–3	110 million EUR + 0.15 (BI – 1 billion EUR)
3	3–10	410 million EUR + 0.19 (BI – 3 billion EUR)
4	10–30	1.74 billion EUR + 0.23 (BI – 10 billion EUR)
5	30+	6.34 billion EUR + 0.29 (BI – 30 billion EUR)

Loss data and LM

Banks with a BI greater than 1 billion EUR (bucket 2–5) must estimate an LM. The LM is calculated based on bank-specific historically observed operational loss data. Therefore, the Basel Committee demands 10 years of good-quality loss data. For a transition period, at least 5 years of loss data is expected.

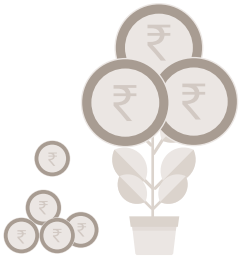
Calculation of loss component

- The loss component is calculated from average annual operational losses, but high losses (losses greater than 10 million EUR and losses greater than 100 million EUR) are weighted higher.
- The LM takes the value 1 if the bank has observed market average operational losses (the loss Component and BI take the same value). In case of above average losses, the multiplier is greater than 1 and thus leads to higher OR regulatory capital (and vice versa).



Key impacts of SMA on banks

Capital	Banks could face increases of up to 70% of their Pillar 1 OR capital charges. • The overall impact will also depend on how the proposed new Pillar 1 approach interfaces with Pillar 2 capital requirements – banks that can demonstrate good internal modelling and strong OR systems and controls could potentially gain a partial offset to higher Pillar 1 requirements. • Banks will need to revise their systems and processes to deliver the required calculations.
Internal loss data	The data requirements for calculating internal loss experience and the proposed disclosure requirements will impose an additional burden on some banks. • Banks not currently using the AMA will have to put the necessary systems and processes in place to collect, analyse and report the required data.
Incentives for good OR management practices	• The introduction of a loss data experience will provide some regulatory incentive for banks to reduce their OR losses. However, this element of risk sensitivity is limited to past losses, and does not include other key elements of the AMA, namely external data, scenario analysis, and the business environment and internal control factors data. • The Pillar 2 capital framework is used as a tool by some regulators to encourage enhanced risk management across banks. However, it remains to be seen how this will be applied by supervisors and how consistently this will be used globally.
Disclosures	• The enhanced Pillar 3 disclosure requirements will require banks to detail how they manage their ORs as well as their loss history: 1. BI value for the last three years; 2. losses for the last three years (including the number of losses and total amount of losses > 1 million EUR, and the total of the five largest losses); and 3. historical losses used for SMA calculation split over the last 10 years (total amount, and total amount > 1 million EUR). • Banks will need to revise their systems and processes to deliver the required disclosures.



Challenges of AMA modelling

Data availability	Data completness	Operational data	ELD	Data reliability
• The loss distribution approach does not differentiate between risks for which there exists a large set of experience data and those for which a very limited amount of experience data is readily available.	• It requires the existence of a complete risk database to provide sufficient data points to assist in declaring which frequency and severity distributions to use and to estimate their parameters. This might be problematic for various reasons. • Data of collapsed companies is not available which results in survival bias.	• Data on operational failures in the history of a given company is very limited and might not be available, particularly for low-frequency high-impact events. • With limited data on operational losses, it is not possible to compare quality of data of a theoretical to an empirical frequency distribution with a reasonable degree of significance or to test for correlation between events.	• ELD is difficult to use directly due to different volumes, risk culture, controls, processes and mitigation techniques in place. External data can only be used after scaling individual loss data to the size of the original company.	• The underlying assumption that the past is a reliable representation of the future may result in under-representing events that never happened in recent memory and for which data is not available, and over-representing events that happened very frequently in the past and that have already been mitigated.

Assumptions	Homogeneity	Risk frequency and severity	Model methods	VaR
• The model is based on the assumption that loss data is identically distributed. • ILD for the same risk category comes from different sources of risks which are not identically distributed.	• Combining loss data from different non-homogeneous distributions can produce spurious results.	• Each risk can occur under a number of wide-ranging scenarios and the intensity and severity of a risk are different for different scenarios.	• Methods used for describing correlation between risks are based on a single correlation assumption, thus ignoring the correlation between risk scenarios and the fact that extreme events for multiple risks tend to occur together.	• VaR is not a coherent risk measure (unless losses are restricted to specific distributions) as it does not satisfy the sub-additive axiom of coherence. • Summing up VaRs can result in overestimating the risk capital.

Other shortcomings of AMA modelling

Risk modelling

- The concept of risk exposure is subject to industry-wide standards for assessing and rating the probability of a loss event.
- OR does not exhibit these properties, largely because there is no systematic, consistent, industry-standard method for collecting and collating data.
- Although a 56 cell matrix (8 lines of business by 7 categories of OR) is described in the framework for collating data, the available data is sparse and is largely randomy anecdotal.
- Data is inconsistent as there is no agreed-upon definition of what 'risk exposure' means, and there are no standards for assessing the probabilities of loss events.

Data collection issues

- Historical records of loss data are incomplete, inconsistent and non-homogeneous. It is almost impossible to automate the collection, collation and analysis of this type of data, requiring in most instances detailed manual activity by experts, which in itself makes the process difficult, error-prone and expensive.
- Another problem is that while this analysis can be done historically for events that have occurred, the complexity of the potential dependency trees that would need to be developed to apply this analysis for forecasting purposes is beyond the economic scope of current modelling. Identifying and calculating correlation between apparently independent factors is also a difficult issue.
- The techniques for predicting future complex loss event types not yet experienced cannot be generalised. The unexpected losses in the tail of the loss distribution are all likely to be of this complex type. In effect, we are denied access to the potential portfolio of ORs that exist because they are not explicitly known and cannot realistically be identified or predicted.
- The data collection process is also subject to the negative effects of a traditional risk culture in banking institutions in which employees have been encouraged to hide errors, poor decisions and criminal activities rather than report them.
- Banks usually truncate the data collection at around 10,000 EUR. Events with losses below this value are discarded because their high volume and relative insignificance in financial terms make them very expensive to collect, relative to the loss values. While this means that only 'significant events' are recorded, there is a huge gap in the data for the underlying causal effects that are characteristic contributors to these major losses. Thus, any loss data distributions developed are based on incomplete data that is biased in an unknown way.

Hidden ORs

- ORs are, by definition, embedded in the operational processes, although their causes may be external or may be related to the failure of the resources that support the execution of business processes, such as people and systems.
- Thus, there are at least two major obvious sources of hidden OR: Unforeseen external events (of a type not previously experienced or known); and events that are embedded in the supporting process resources in such a way as to be difficult to identify and monitor.
- The first category will always be problematic, unless we make some major leaps in the art of clairvoyance, but the second category is more within our potential control.

Homogeneity of loss data

- Despite the standardisation of the 56 cell matrix mentioned above, there is no attempt within that framework to identify the causes of the loss events. In order to fit a loss distribution to given data, it is essential that the data elements are all from the same homogeneous distribution, and this leads to the need to define homogeneous cells at an appropriate level in the hierarchy of the business line/event type matrix.
- Part of the problem is the context dependency of operational risk. The size of the loss and probability of the event differ considerably according to the circumstances surrounding the event. It is a fact that the business context, the nature of the operational infrastructure and the threat scenarios change over time, in some cases quite quickly, and so historical data collected in one context may not be applicable in the current context.
- This brings into question the relevance of historical loss data. Even within the one-year time period specified in Basel III, within which the accumulated losses must be covered by capital allocation, the context of those losses can change dramatically. This means that the size of potential losses and the probability of them occurring are continuously moving targets. How useful then is the assumed loss distribution?

Our perspective on four AMA data components

ILD

- ILD calculation needs to be comprehensive,accurate and consistent as it is a key building block of informing frequency (by event type), expected losses and severity distributions.
- It represents the idiosyncratic component of the Opertional risk profile of a financial institution. To enable this, firms need to:
  - put in place robust and clear risk/event definitions and procedures;
  - ensure losses captured in the database reflect the full occurrence of losses in the business (through mechanisms such as a reconciliation against the general ledger, validation and review, etc); and
  - verification of data comprehensiveness and quality
- On the basis of a comprehensive exploratory data analysis and benchmarking, PwC developed a set of tools to help our clients understand the completeness and quality of their internal loss data. We can also support the design and implementation of a robust process to collect and reconcile operational risk data.

ELD

- Every external data source has a bias of some sort, whether obtained from historical insurance claims files, the public domain or a data consortium. As a consequence, the intricacies of how to use these different data types need to be carefully considered when parameterising a model in terms of impact on the tail and capital stability over time.
- Approach to operational risk modelling clearly identifies the contribution of the systemic and idiosyncratic components, as required by the regulators.

Scenario analysis

- Scenarios are an important tool for the assessment of exposure to unexpected loss, utilising a combination of internal and external loss experience, together with expert opinion and business engagement. However, their use to derive meaningful data for input into an AMA model is challenging. Key considerations are:
  - the level within the business for use (hub selection);
  - risk coverage within each hub;
  - metrics to capture;
  - how to prepare for and engage with stakeholders;
  - collation of realistic and consistent parameters; and output.
- We have developed a structured approach to scenario analysis, drawing on a combination of detailed loss data analysis and utilising information on internal and external events. This approach involves:
  - Business segmentation and selection of risk classes, e.g. by Basel event type or model risk category
  - Stakeholder identification for subsequent engagement
  - Pre-interview analysis and preparation, including statistical analysis of historical internal and external data, storyline development and selection of industry loss examples
  - Scenario interviews and workshop undertaken to gather a detailed understanding of how losses or risk within each event type being evaluated may materialise and to assess and agree on exposure informed by robust data analytics
  - Post-workshop refinement and sign-off

BEICFs

- There is a perception in some jurisdictions that BEICFs are not an important input into an AMA or internal model and that they are in fact not sought by some regulators.
- This has largely been driven by negative feedback from regulators on BEICF data, which is usually focused on the qualitative assessment of risk and controls. Banks collect a high amount of information that could be actively used for operational risk modelling.
- Few banks use BEICFs in their model, and where they do, they do not impact capital in a way expected by regulators. In most jurisdictions, regulators are encouraging firms to develop structured BEICF approaches that facilitate the realistic assessment of exposure to specific OR components.
- Developed a proprietary methodology to incorporate BEICFs in AMA modelling. This methodology uses such a component as a weighting mechanism between quantitative and qualitative estimates.

Managing the challenges of the AMA model

The AMA model for risk management has three evolutionary stages:

	Stage 1	Stage 2	Stage 3
	Foundation elements	Implementation and execution	Capturing value
Objectives	Build foundation elements for model risk management (MRM)	Implement robust MRM	Gain efficiencies and extract value from MRM
Key elements	• MRM policy • Model inventory • Manual workflow tool • Model governance and standards • MRM organisation – governance team • Validation team	• MRM policy • Control and processes • Training for stakeholders • Model governance and automated workflow tool	• Centre of excellence for model development • Industrialised validation • Transparency in model quality • Process efficiency tracking • Optimised resource management

Model design, buid and calibration

Models being built by AMA banks are often technically advanced, relying on new advances in the field of

stochastic and operational risk modelling, but with limited experience of their application across the industry.

This can lead to issues in comprehension of the theorems used in practice, calibration routes, goodness of fit tests and stability.

Careful consideration needs to be given to the use of the model. The key to building a robust and stable model is to adopt a pragmatic and proportionate approach. This will enable a firm to meet its objectives (invariably including capital stability over time), comply with regulatory requirements and understand its business and model risks.

Model units of measure

Models often have many units of measure, resulting from a desire to develop a structure that reflects the risk matrix of standard Basel II taxonomy. However, model granularity on this basis typically suffers from a lack of data to inform parameterisation, and leads to instability of results and capital numbers driven by aggregate losses rather than single large losses. It also results in a need to apply considerable diversification to generate capital values considered to be appropriate.

Reporting

The recent European Banking Authority (EBA) guidelines focused on the issue of modelling assumption reporting, requiring adequate disclosure and sensitivity on model assumptions. Our approach is to clearly identify at least three sets of documents:

(i) the methodological document, describing the assumptions adopted for modelling;

(ii) a 'first-time adoption' document, reporting the analysis underlying the methodological assumptions and modelsensitivity; and

(iii) the capital calculation report.

Thorough model validation, undertaken by appropriately skilled internal or external resources, should address the documentation challenge. Review and challenge or validation work should pay particular attention to results and whether business judgement is consistently applied throughout the framework and in line with the documentation produced.

Use test and risk mitigation

Demonstrating that the model helps business decisions aimed at reducing and managing OR is often a challenge. When well designed, taking into consideration the reporting needs of each stakeholder, model outputs can be used to:

(i) prioritise and manage the reduction of expected losses through investment in the control environment;

(ii) inform new and existing product risk evaluation and control, in conjunction with a scenario analysis framework; and

(iii) compensation management strategies.

Integration

Complex models could potentially work as 'black boxes' where the effect of the different model components is not properly and intuitively understandable. We have worked on a package of integration techniques to overcome this challenge, both for the integration of internal and external data and for the integration of quantitative (LDA) and qualitative (scenario) components. The use of BEICFs in the integration process could guarantee the active consideration of the fourth data element in the model itself.

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