CAFRAL

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Business Environment and Internal Control Factors (BEICF): Practices and Trends

Ernst & Young

Quality In Everything We Do

Context Setting
Subjectivity is necessary, but needs to be transparent

- Regulators don't give detailed formal guidance for AMA; they impose their preferences through the supervisory review process as they form based on evolving industry practice
- Make maximum use of all available information
- Things should be as simple as possible but not simpler
- Move over textbook; do the experiment
- Be proportionate & pragmatic for the sakes of transparency
  - E.g., to understand if enough simulations are being performed, run the model several times and see if the number changes

The most commonly used BEICFs tools are RCSAs (98%), audit results (90%), and KRIs/KPIs (81%)*

*Observed range of practice in key elements of Advanced Measurement Approaches (AMA) BCBS 2009

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2. Trends in modelling and measuring BEICF
3. Imperatives of BEICF buy in
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Regulatory expectations
Attributes of Good BEICF

- In addition to using operational risk loss data, whether actual or scenario-based, a bankôs operational risk measurement system must incorporate indicators of the bankôs operational risk profile, as well as other information related to the assessment of the bankôs internal control framework collectively termed as **Business Environment and Internal Control Factors (BEICFs).**

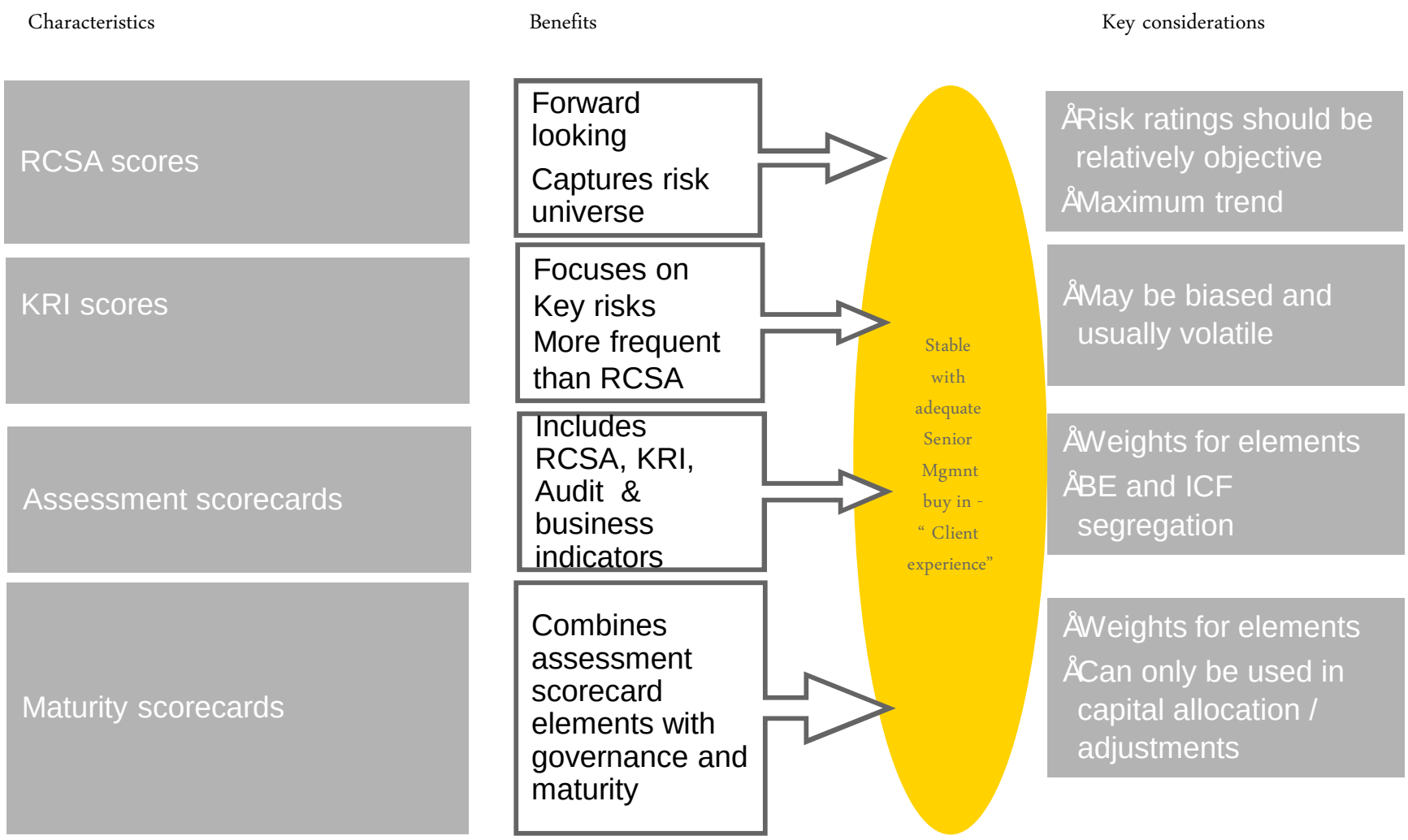
- These factors must be responsive to changes in the bankôs operational risk profile and reflect potential sources of operational risk.

- Where possible, business environment and internal control factors should be translated into quantitative measures that lend themselves to verification.

- where estimates of the 99.9th percentile confidence interval based primarily on internal and external loss event data would be unreliable for business lines with a heavy-tailed loss distribution and a small number of observed losses. In such cases**, scenario analysis, and business environment and control factors, may play a more dominant role in the risk measurement system.**

1 Identifying BEICFs

Justify the choice based on considerations of historical experience and involving the expert judgment of relevant business areas.



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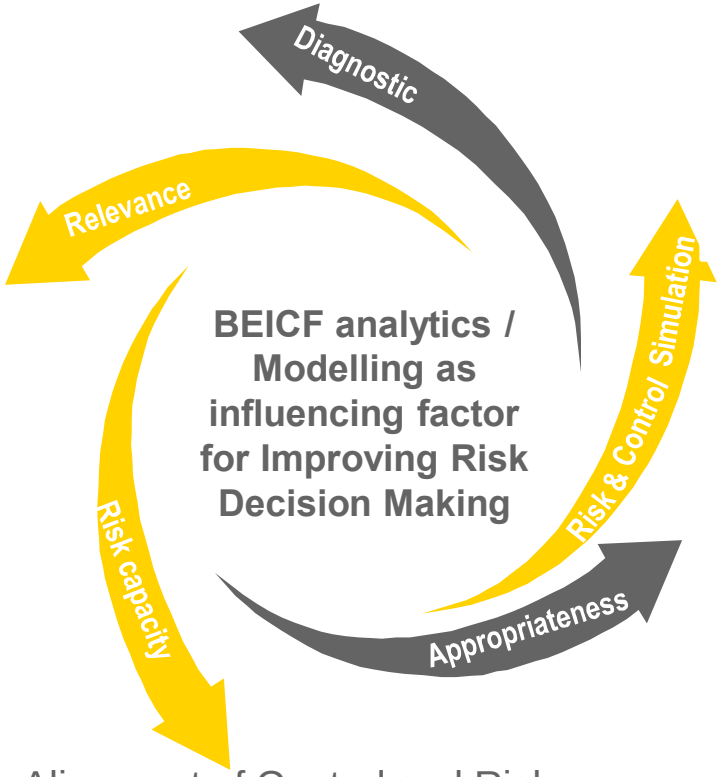
Trends – Modeling and measuring BEICFs

Leveraging investments in OR Measurement approaches to facilitate decision making- use test

Enhanced decision-making capability based on more effective and meaningful management information

Drive quality and consistency in risk identification and informs scenario assessments



Make risk measures accessible and understandable, implications of business decisions

Establish of relevance of loss data to current and target operating environment

Alignment of capital allocation to risk and control environment

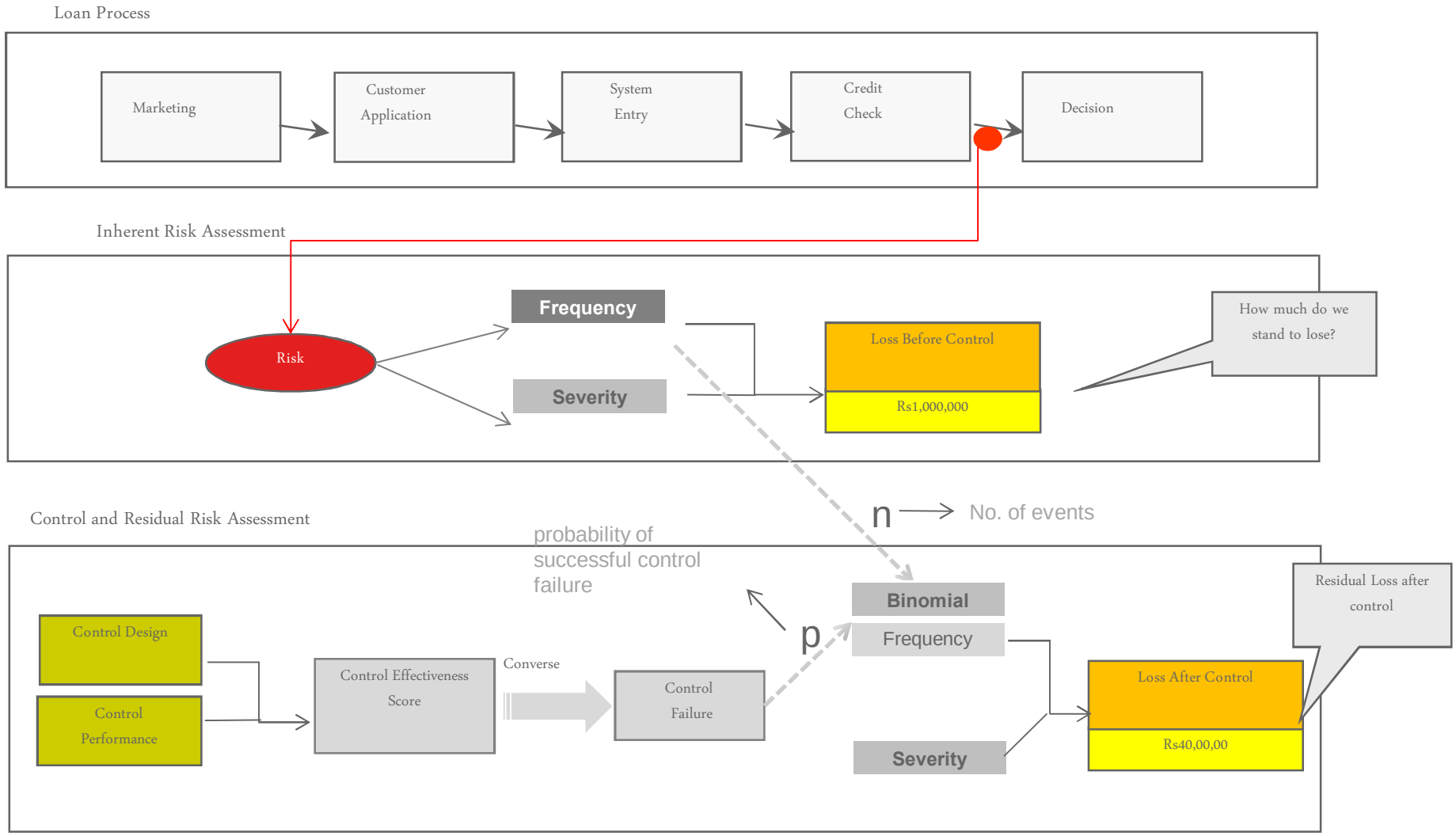
Alignment of Control and Risk Appetite & metrics to monitor risk taking

Trends – Modeling and measuring BEICFs

Observed practices in modeling and measuring BEICFs

- Direct loss simulation of BEICF data- sub AMA model
- BEICF as one of inputs in capital model
  - Input scaling
  - Capital allocation
  - Output / capital scaling
- Usage of BEICF in CCAR framework
- Indirect usage- Information role

1 Direct loss simulation of BEICF data-
Overview – Risk and Control Simulation



Risk and control analytics for informed business process reengineering

Control Costs & Returns - Demo

CC Risk Controled	1	CC Failure to identify all relevant laws and regulatory requirement
Control Name:	1	Compliance team review daily newsletters received from various sources which inform of regulatory changes and e
Control Name:	2	Attendance at informal peer industry compliance forum monthly.
Control Name:	3	Review of circulars sent by Investment Managers Association.
Control Name:	4	XYZ Senior management participation at industry forums provides compliance team advice and notification of indust
Control Name:	8	Escalation of significant regulatory requirements or issues by Head of Compliance at ERFC.

Loss without Control	Loss after Control	Control Savings	Control Costs	Control Return
41,850,651.72	16,910,927.46	24,939,724.25	25,000,000.00	-0.24%

CC Risk Controled	2	CC Failure to inform and advise individually identified managers of regulatory issues and requirements.
Control Name:	7	Monthly compliance report submitted to the ERFC with details of emerging regulations.
Control Name:	8	Escalation of significant regulatory requirements or issues by Head of Compliance at ERFC.
Control Name:	9	XYZ compliance team regularly attend some local management team meetings.
Control Name:	11	Experienced and long serving compliance staff are able to identify which members of the business to consult.
Control Name:	58	Trades that breach client guidelines are flagged by pre-order automated compliance check of guidelines.
Control Name:	69	Compliance staff provide formal and informal training and knowledge transfer to the business.

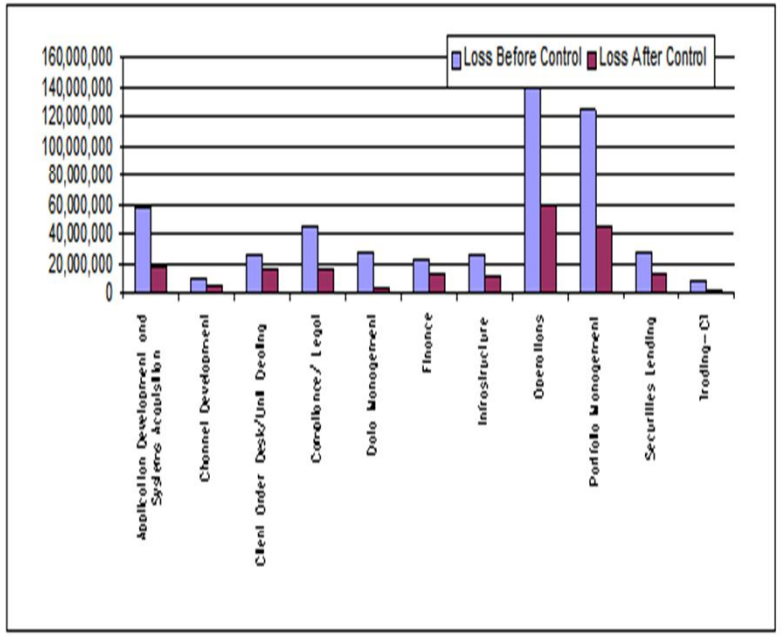
Loss without Control	Loss after Control	Control Savings	Control Costs	Control Return
50,653,994.02	10,592,522.65	40,061,471.37	33,000,000.00	21.40%

CC Risk Controled	3	CC Failure to monitor business compliance with relevant regulations
Control Name:	3	Review of circulars sent by Investment Managers Association.
Control Name:	9	XYZ compliance team regularly attend some local management team meetings.
Control Name:	10	Membership on project steering committees enables compliance to provide regulatory input.
Control Name:	16	Exceptions identified from price movement reports are checked against an independent second source prior to rele
Control Name:	70	Compliance monitoring programme carried out on a regular basis.

Loss without Control	Loss after Control	Control Savings	Control Costs	Control Return
41,928,855.32	12,593,018.40	29,335,836.92	27,500,000.00	6.68%

Results By Processes

Current DataSet is Demo



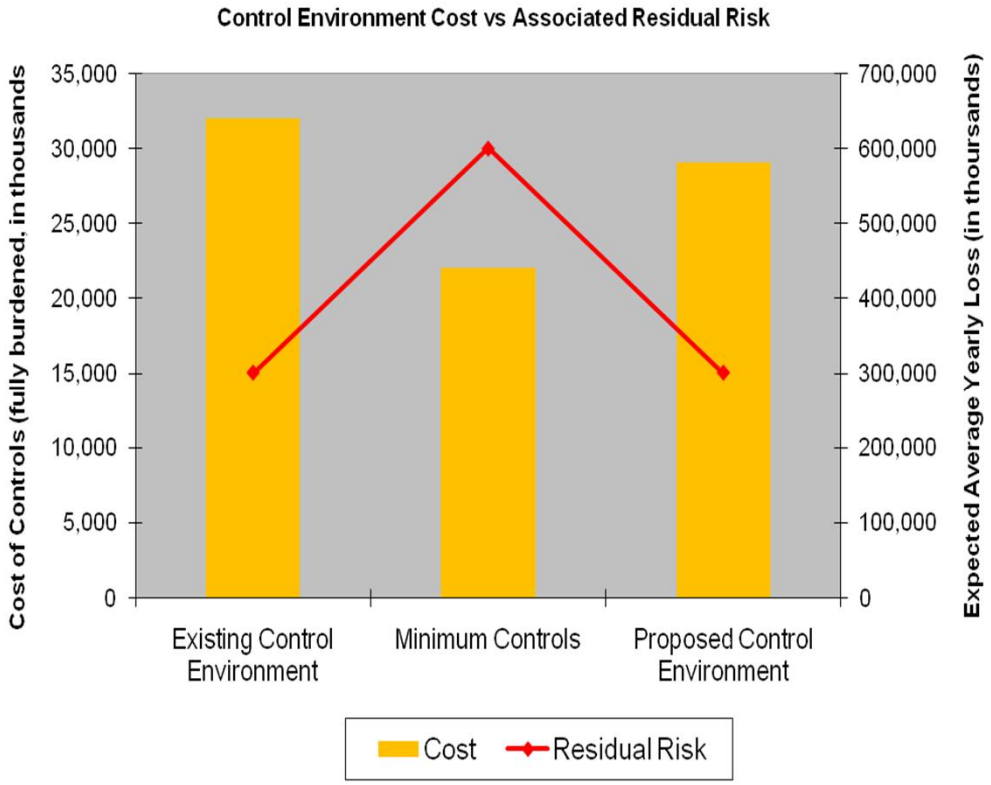
Overall Results

	Loss Before Control	Loss After Control	Control Improvement	
Total	510,783,510	199,347,643	311,435,867	60.97%

Risk and control analytics for informed business process reengineering

Control Optimization Report

Issue	Å **Too many 'seat belts'** Å **Inefficient + Slow+ Bureaucratic**
Our Approach	**Examine the impact of reach controls through risk and each control simulation**
Value	Å Unit **saved** Rx xxx **through reducing costs without increasing their risks.** Å **X% of controls eliminated**



Direct loss simulation of BEICF data-
Point of View

- Benefits
  - This provides a measure to compare various risks and processes using the VaR numbers
  - This can be used to perform a cost and benefit analysis of the controls associated with various risks
- Limitations
  - The type of models which can be fitted using this approach are limited..
  - The number of variations of models are also fixed as the parameters depend on the rating scales

This approach is not accurate from the capital computation standpoint. It should only be viewed as a measure of comparison between risks and controls.

2 BEICF in Capital model
Input Scaling – Parameter Scaling

- The Operational risk losses during various years depend on the BE factors such as business size, number of employees etc. This approach assumes that the parameters of the distributions fitted to the losses would change along with these BE drivers.
- The distributional parameters should be expressed as a function of the applicable BEICF drivers like below ï
  - Lambda = function (#of transactions, #of employees, etc.), where Lambda is the parameter of Poisson distribution
  - Mu = function (Business size, Ticket size, etc.) where Mu is parameter of Log-normal distribution and so on.
- The above function can be linear, log-linear etc.

- There is no direct solution available for the distribution parameters or the relationship as shown above. An iterative approach needs to be taken to obtain the MLE estimates.

3 BEICF in Capital model
Input Scaling – Data adjustment for relevance

Objective:

Establish relevance of input by the scaling the input losses directly.

- The losses are first generated by simulating the loss frequency and severity values using appropriate distributional assumptions and estimation techniques
- The losses are scaled to reflect current size and complexity of the business using the BEICF data as proxy and the scaled losses of the entire time period would be used for modelling together.

- Step 1: Express the losses as a combination of BEICF data (using regression techniques) to achieve relationship of losses with the potential factors, such as size of the business, employee strength etc.

  Thus, the loss function will be of the following form:

$$Loss = f(BEICF1, BEICF2, ..., BEICFn)$$

- Step 2: Derive the scalar for each year by comparing the current and that particular yearôs BEICF factors.
- Step 3: Apply the scalar appropriately to scale the frequency and severity both.

BEICF data for Scaling
Considerations

APPROACH	Considerations
Parameter Scaling	Most sophisticated methodology, but requires relatively greater amount of data
Data Adjustment and Modeling	Simpler to implement, relatively requires less data, but less stable as the losses would have higher fluctuations, the relationship would be less stable

- The most commonly used model looks like below:
  - Log(loss) = Common part+ Log(Size) + Other factors
  - Other factors can be Country, business line, risk type etc.

BEICF data for Scaling
Point of View

- Limitations/drawbacks of Scaling Approaches
  1. The external data are reported above an unknown truncation threshold
  2. Its difficult to identify correct & appropriate risk drivers for ELD data
  3. The magnitude of the coefficients derived from actual data set may be substantially lower than the benchmarks*, and several of the variables may not be statistically significant at even the 90% confidence level.
  4. Although there are various approaches suggested for scaling of loss data/parameters, the models are found to be unstable in nature

The scaling of loss data has been found to have inconsistent impact on the capital requirement and this coupled with low explanatory power is a major contributor to why this is not a prevalent trend

* *example*-Dahen and Dionne

BEICF in Capital model
Capital Allocation– Introduction

- Capital allocation allows the overall Capital Requirement (CaR) to be decomposed into contributions from business lines (or Unit of Measure level, if necessary)

- If the overall CaR is CaR_T, a (linear) allocation key can break this down into individual contributions for business line ***i*** ,

$$C_i = \psi_i \, CaR_T$$

- CaR (and Expected Shortfall) measures are *usually* not-additive
  - In general, standalone capitals for each business line do not add up to overall capital

$$CaR_T \neq \sum_i CaR_i$$

  - However, CaR is only additive when business lines are fully correlated e.g. $\rho = 1$
  - Non-additivity is due to the effects of diversification and dependency

Capital Allocation
Key Requirements

- Qualitative requirement of a good allocation approach are:

Transparent	**Business lines should be able to reconcile their own standalone experience and understand their contribution, to ensure "buy-in".**
Representative	The allocation key should adequately reflect the risk profile of each business.
Stable	The allocation key should not be sensitive to large individual events, unless there has been an underlying change in the risk or control environment of each business line.
Incentivises risk management	Senior management within the business lines having understood their own standalone capital and their allocated capital in context, could use this information as an input to their operational risk management.

- The allocation should maintain the below relationships:
  - **Sub-additivity:** CaR(Unit1) + CaR(Unit2) >= CaR(Unit1+Unit2)
  - **Scalability:** CaR(c. Unit1) = c. CaR(Unit1)
  - **Monotonicity:** If risk level of Unit1 is more as compared to Unit2, then CaR(Risk1) >= CaR(Risk2)

Capital Allocation
Key Considerations

- Balanced scorecard allocation is an example of a BEICF-based allocation key:
  - Weighted scoring of relevant internal risk, performance and control factors.
  - The allocation key would be based upon the score derived above.
  - Elements of the scorecard might also include standardised financial indicators and risk metrics.
- *Advantages of approach*
  - Simple to implement
  - Reflect the internal drivers of the risk profile for each business line
  - Allows allocation at a deeper granularity than UoM
  - Use test compliance
- *Disadvantages of approach*
  - Indicators may be multi-collinear and thus some element of ñdouble-countingò in naive scoring.

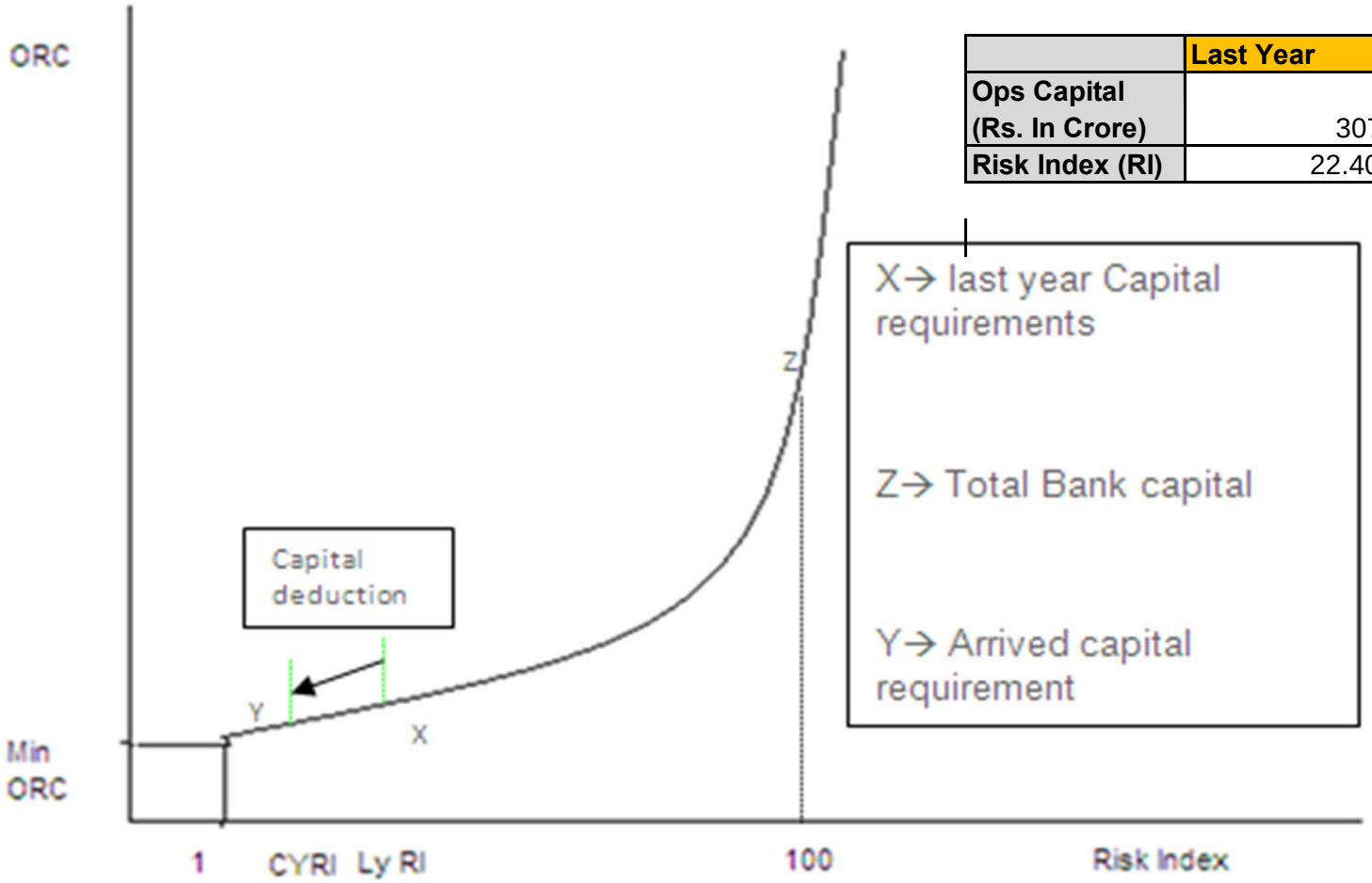
Most consistent and traceable approach and aligned with risk management granularity

5 BEICF in Capital model
Output / Capital adjustments– Overview

- In this type of approach the loss data or the input parameters are not scaled. Instead the final modelling outputs i.e. the Capital Requirement numbers are adjusted up or down depending upon the BEICF drivers.

- **Objective:**
- Relate the Capital requirements with the BEICF based index for each particular year. The relationship can be based using either Bank-wide or business unit-wise risk index measures.
- Depending upon whether the Index has improved up or detoriated, the Capital requirement output would be scaled up or down

BEICF in Capital model
Output / Capital adjustments– Illustration



	Last Year	Current Year
Ops Capital (Rs. In Crore)	307.5	378.2
Risk Index (RI)	22.40%	26.30%

BEICF in Capital model
Output / Capital adjustments– Considerations

- Benefits
  - The approach is quite simplistic
  - Easier to interpret since the Capital is directly linked to the BEICF index/ Risk index
  - Transparent tool for use test
- Limitations
  - Data scarcity (annual capital requirement and Risk Indices) to derive relationship
  - In case of lack of data, assumptions to be made about the relationship of Capital and Risk *Index.*

Most intuitive approach but may have buy in challenge due to components of BEICF and assumptions in relationship between risk index and capital

* *example*-Dahen and Dionne

6 Usage BEICF in CCAR framework
CCAR– Introduction

- The Comprehensive Capital Analysis and Review (CCAR) involved the Federal Reserveôs forward-looking evaluation of the internal capital planning processes of large, complex bank holding companies and their proposals to undertake capital actions such as increasing dividend payments or repurchasing or redeeming stock.

- On November 17, 2010 (Final rule ï 12th Oct, 2012), the Federal Reserve issued guidelines to provide a common, conservative approach to ensure that these bank holding companies hold adequate capital to maintain ready access to funding, continue operations and meet their obligations to creditors and counterparties, and continue to serve as credit intermediaries, even ***under adverse conditions***.

- While the plans contain numerical estimates of. stress tests, the plans are much ***broader in scope and objectives*** and are intended to provide a comprehensive view of each firmôs overall ***capital adequacy processes*** and to reinforce incentives for the firms themselves to take a comprehensive and forward-looking approach to assessing capital needs and developing appropriate capital plans.

Usage of BEICF in CCAR framework
Operational risk stress testing: CCAR

Objective: A model to project operational risk loss. The model would take pre-specified macroeconomic scenarios as inputs and estimate quarterly losses over a 9-quarter time period under baseline, adverse and severely adverse economic scenarios.

- To align with the AMA approach and the regulatorsô expectation, the operational loss projection model would compose of two components: a) A loss frequency model , b) A loss severity model

- The purpose of the loss frequency model is to estimate quarterly loss frequency for a given economic scenario. For each unit of measure (UOM formed as per the AMA quantification model), correlation analysis would be performed to determine:
  a) Whether the relationship between internal loss experience and BE data (macroeconomic conditions) is pro-cyclical or counter-cyclical, and
  b) Which macroeconomic variables are more predictive for frequency modeling. Several transformations of both dependent and independent variables can be examined in this process.

Usage of BEICF in CCAR framework
Operational risk stress testing: CCAR

- The purpose of the loss severity model is to estimate the expected severity amount per UOM under a stressed period. ➡

- In addition to the operational loss projection model, banks would also conduct scenario analysis as per their own historical data and the associated macroeconomic conditions to estimate potential losses.

- Results based on both models and scenario workshops would be compared to form the final loss projection for each unit of measure.

Usage of BEICF in CCAR framework
Operational Risk in CCAR: Consideration & Challenges

- Finding and estimating correlations between macroeconomic factors and operational losses are troubled by:
  1. Completeness of data(internal and external)
  2. Truncation of loss databases ï Inconsistencies in thresholds used
  3. Natural scarcity and aggregation there of resulting in spurious correlation- for example, WTI crude oil prices, aggregated quarterly using ORX data, show a 32% correlation with business disruption and system failure losses)

- Globally, relationship is assessed through frequency rather than severity

- For several important operational risk types, the lag that exists between a macroeconomic event and the losses might be expressed in many years, well beyond the scope of the exercise (e.g. as per US Fed CCAR requirements, Bank needs to project total expected operational losses on a quarterly basis for the upcoming 9 quarters.

Usage of BEICF in CCAR framework
Possible solution: Using RBI database

- Operational loss data issues described in the previous slide are not easy to resolve

- As part of a possible India specific CCAR process, banks would start reporting their losses regularly to the RBI. Using this data, the RBI, taking a cue from its US counterpart, can find useful statistical relationships between certain types of operational losses and market/macro variables based on the pooled loss data of around 51 scheduled public sector and private sectors banks in India and the other prominent scheduled foreign banks in India..

- Individual banks correlation exercises probably would fail to provide many meaningful relationships, as being witnessed in the US CCAR exercise.

- Banks would be interested in learning more about those industry-wide findings from the possible RBI exercise since they could be valuable to guide each Bankôs individual AMA and stress testing modeling efforts.

5 Imperatives for BEICF buy in Governance and use-testing

Governance

- Do senior management have understand the model methodology, key drivers, assumptions etc?
- Review oversight around end-to-end process, ensuring appropriate senior management sign-off
- Model parameter sign off process / governance
- Model governance standards, processes and documentation applied to the OpRisk model
- Ongoing validation process

Use Test

- Are model outputs / related MI produced in a timely manner, actionable and aggregated to an appropriate level of detail for each key stakeholder group?
- Are the model outputs ôusedô in the business?
- Is there meaningful feedback between the risk management and model processes?
- Is the maturity of BEICF reflected in measurement models

5 Take aways
BEICF must reward improvements in risk management

1. Accuracy is a difficult concept in operational risk modelling, so consistency and conceptual elegance in design are vital
2. Understand the model sensitivities and ensure they are plausible and meaningful
3. Minimal sensitivity to arbitrary / highly subjective assumptions
4. Where subjectivity is required, isolate it, document it, and try to set as many parameters as possible on a best estimate basis
5. Leading practice is to recognize the relative strengths and weaknesses of the various components of BEICF and them judicially.

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Appendix I - Reference

3 FAQs: Supervisory Methodologies in CCAR 2012, Federal Reserve Bank, pg. 19, ñLoss severity was calculated as sample averages by event type for each BHC during a stressed period and was not conditional on macroeconomic variables included in the supervisory stress scenario.ò ⟹

Appendix II - Example

- One example is litigation losses (mostly under the ócclients, products and business practicesôrisk type). Banks did not start to set reserves for litigation arising from the mortgage crisis in the US in 2007/8 until 2011. The cycle for litigation can take from three to six years, or longer. Considering the regulatory stress tests (CCAR exercise in US) only span a couple of years ahead (upcoming 9 quarters), it is difficult to find a meaningful correlation between a certain macroeconomic scenario and litigation losses within this time frame.