Allianz

Loss Distribution Approach

OpRisk

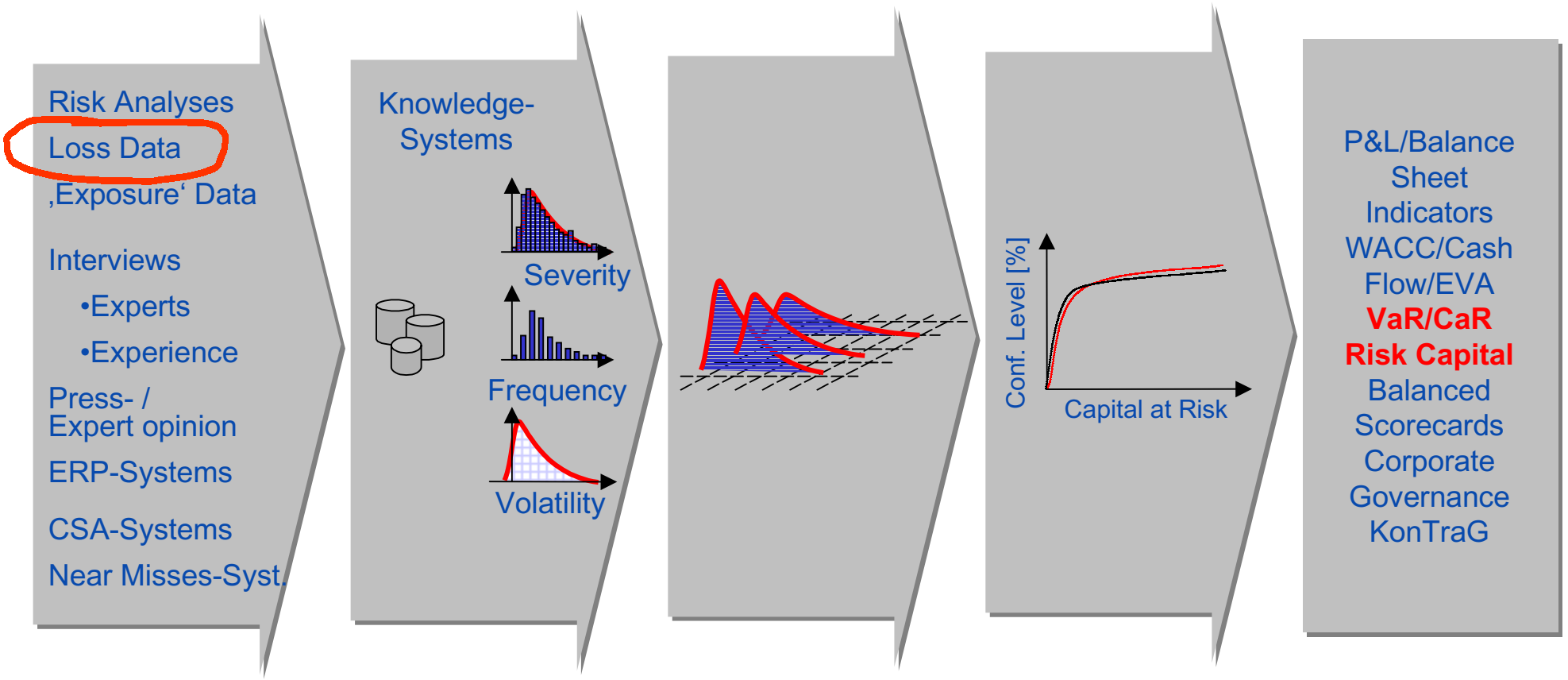
Capital Allocation for Operational Risk Conference
November 14th - 16th, 2001 - Boston

- G. Courage -

Global Risk Division/Risk Consulting

From Risk Information to Risk Capital

Data Collection	Loss Distributions for Single Risks	Risk Map	Integrated Annual Loss Density Function	Target



Contents

- Prerequisites
- Treatment of Data
- Calibration of Parameters
- Loss Distribution Approach
- Integration of Risk Transfer Options

A consistent Typology of Risks is the Prerequisite .....

Loss of Use

War

Customer Intake and Documentation

Transaction Capture, Execution&Maintenance

Act of Government

Strike/Riot/Civil Commotion

Customer/Client Account Management

Expropriation

Diversity&Discrimination

Unauthorized Activity

Monitoring and Reporting

Suitability, Disclosure&Fiduciary

Safe Environment - Third Party

Product Flaws

Vendors&Suppliers

Advisory Activities

Trade Counterparties

Political Risks

Improper Business or Market Practices

System Security

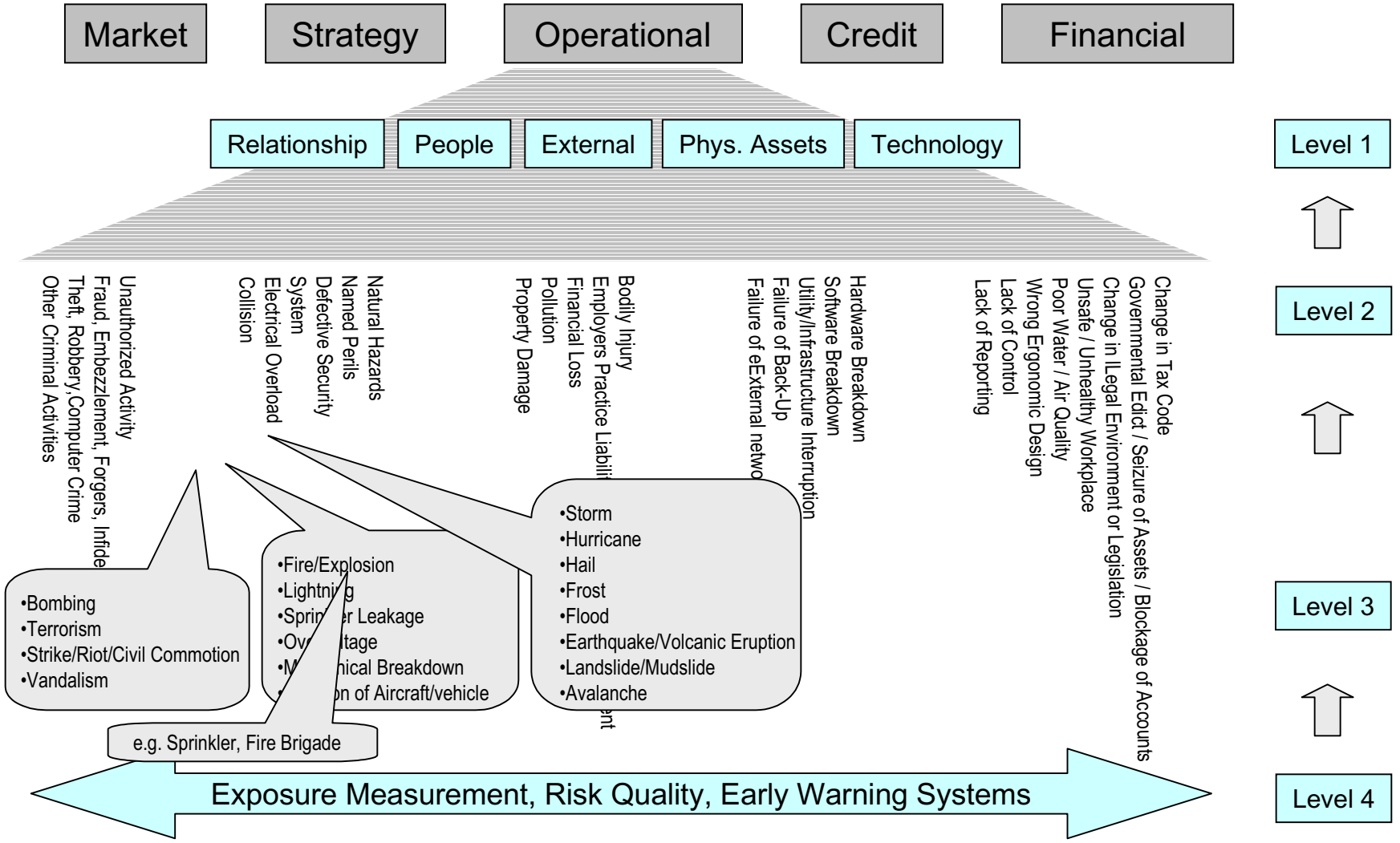
Natural Disasters

Theft and Fraud

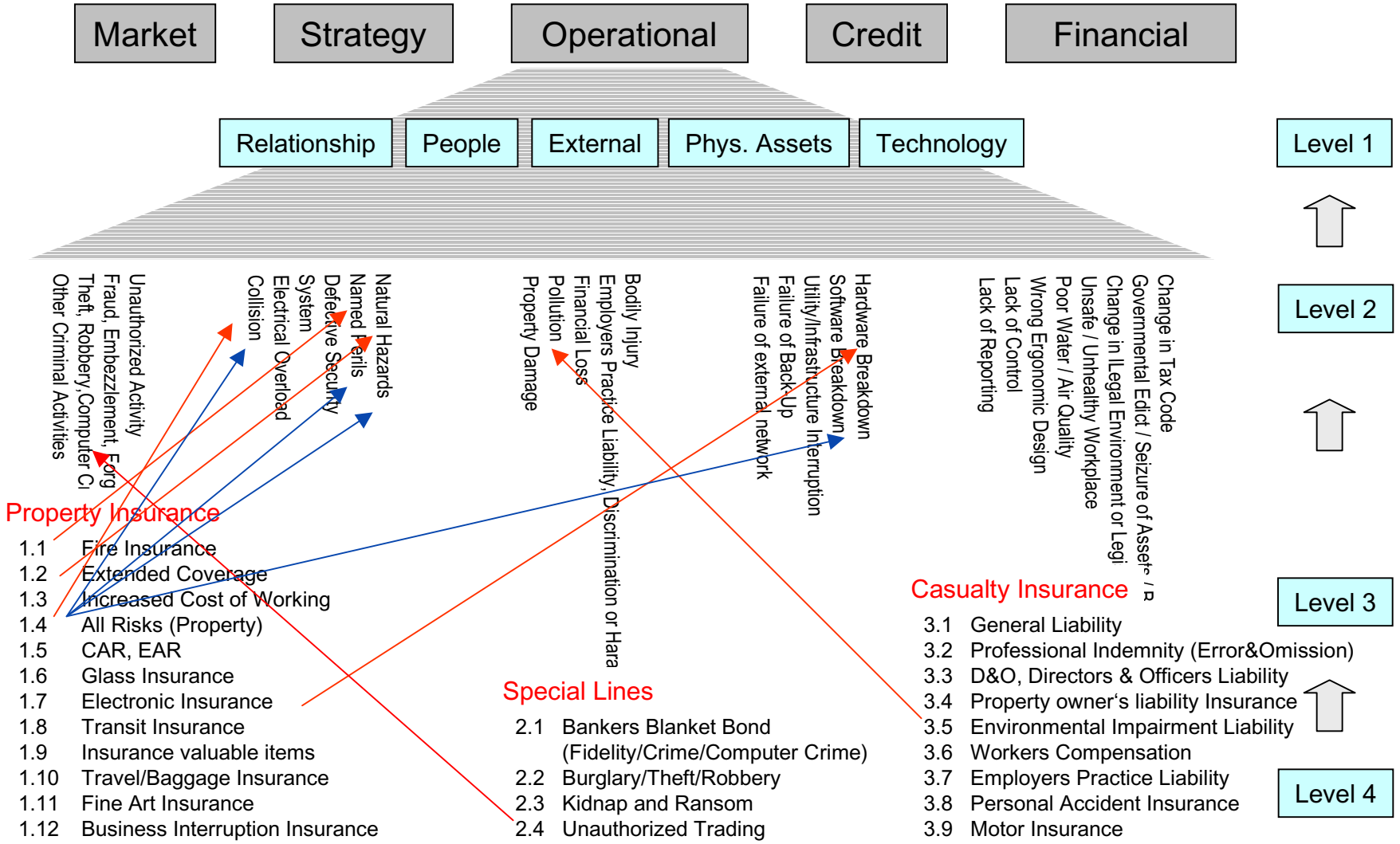
Employee Relations

Safe Environment - Workers

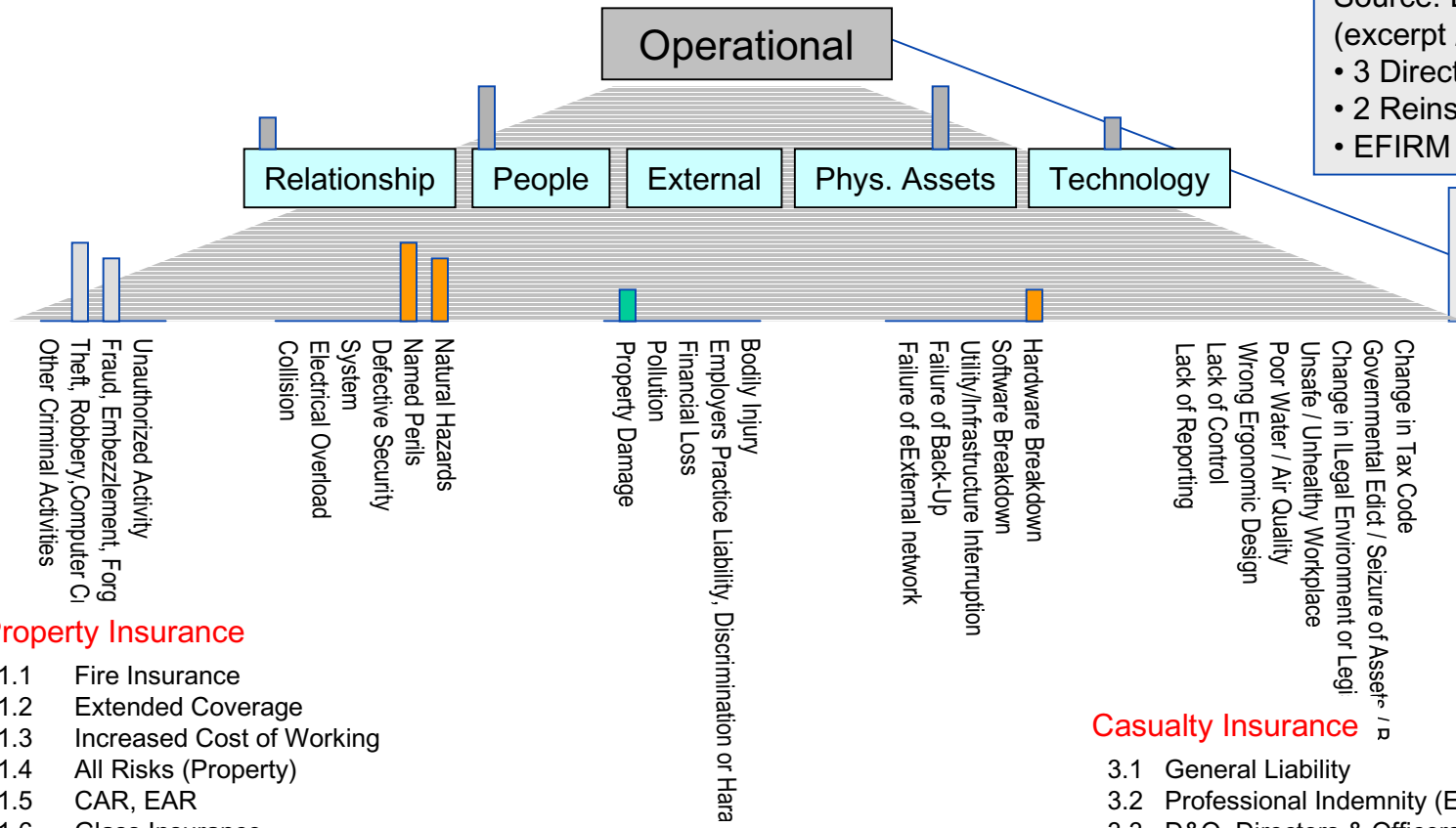
...to map Perils against the Definition of Operational Risk



...and simultaneously to map Mitigation Options against Perils



How this works in practice ?



Source: EFIRM
(excerpt / last 5 years)
- 3 Direct Insurance Companies
- 2 Reinsurance Companies
- EFIRM Banks

Insured Losses totaling to 3 billion US$

Property Insurance

1.1 Fire Insurance
1.2 Extended Coverage
1.3 Increased Cost of Working
1.4 All Risks (Property)
1.5 CAR, EAR
1.6 Glass Insurance
1.7 Electronic Insurance
1.8 Transit Insurance
1.9 Insurance valuable items
1.10 Travel/Baggage Insurance
1.11 Fine Art Insurance
1.12 Business Interruption Insurance

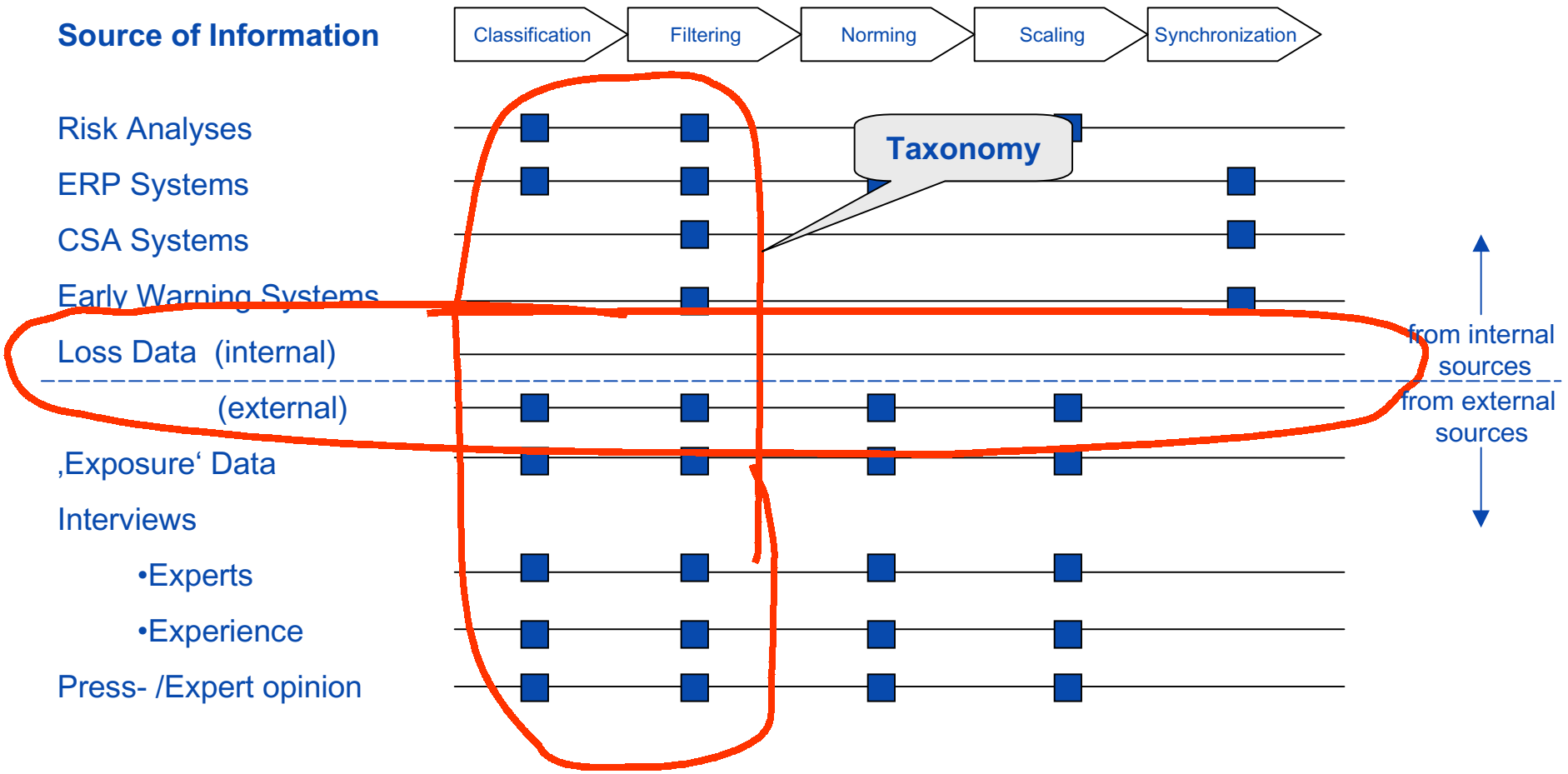
Special Lines

2.1 Bankers Blanket Bond (Fidelity/Crime/Computer Crime)
2.2 Burglary/Theft/Robbery
2.3 Kidnap and Ransom
2.4 Unauthorized Trading

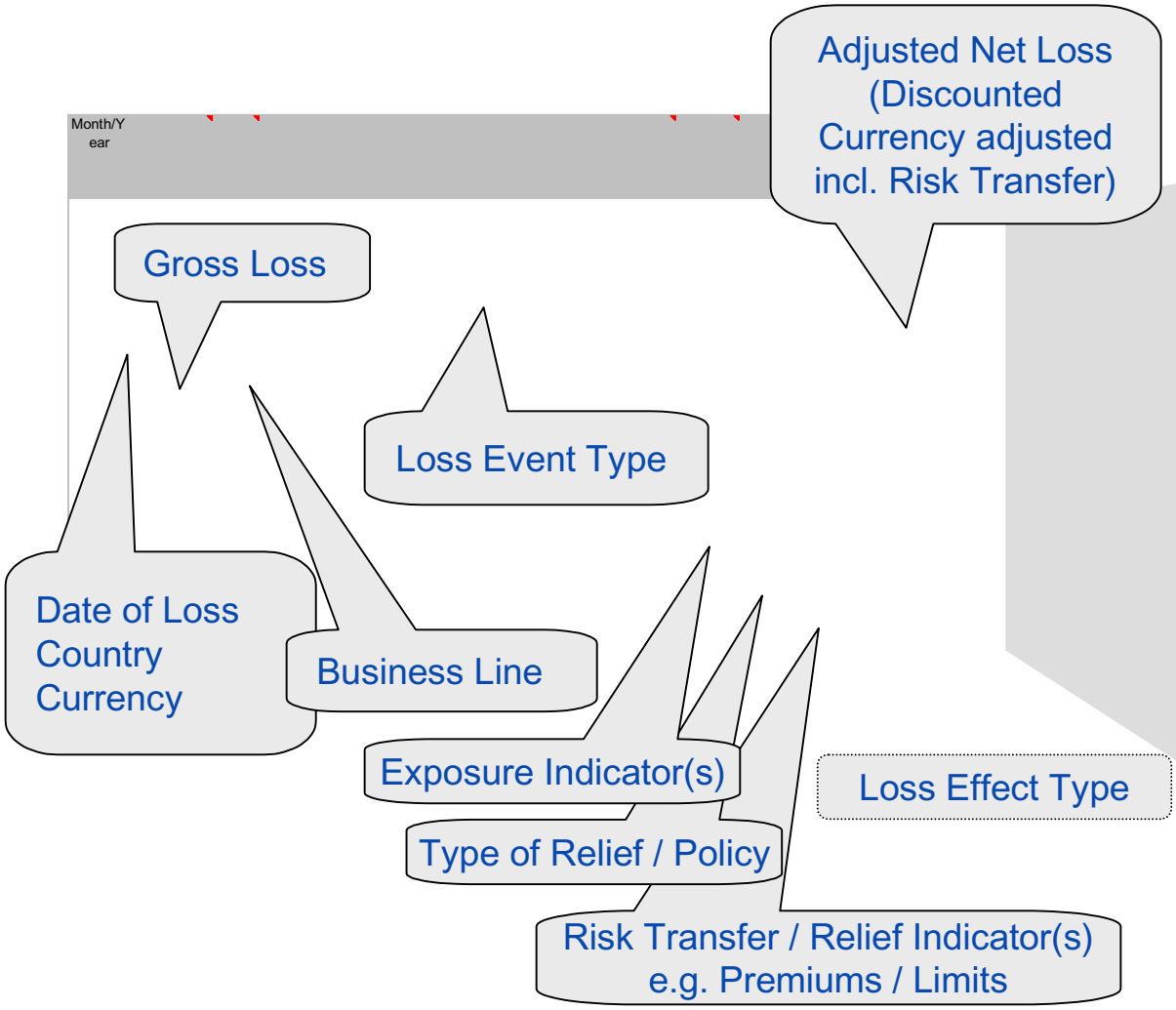
Casualty Insurance

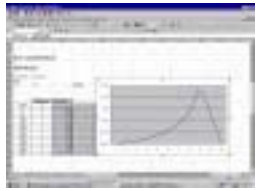
3.1 General Liability
3.2 Professional Indemnity (Error&Omission)
3.3 D&O, Directors & Officers Liability
3.4 Property owner's liability Insurance
3.5 Environmental Impairment Liability
3.6 Workers Compensation
3.7 Employers Practice Liability
3.8 Personal Accident Insurance
3.9 Motor Insurance

Generating reliable Data from multi diversified Risk Information (‚DataMining')



What (Loss describing) Data to collect (1)





Severity

Frequency

Time Trigger

What (Loss describing) Data to collect (2)

- Required Data (Proposal) -

Above minimum threshold

- Gross loss
- Net loss
- Currency
- Country of occurrence
- Date of occurrence
- Event Type / Risk Category (RC) (at least level 2)
- Business Line (BL)
- Loss Effect type (LE)

Above Expected Loss threshold

- Event Type / Risk Category (more detailed, level 3 or additional levels)
- Causative/ Contributory factor(s) (CC)
- Product/ Process/ Function type (PP)
- Type of insurance coverage / Relief Type (RT) applicable (e.g. bankers blanket bond, property, etc.)
- Date of discovery
- Date of insurance recovery
- Status of loss (open/ closed)
- Value of Exposure Indicators at time of loss (e.g. gross income, assets managed) (EI)
- Value of Relief Indicators at time of loss (e.g. insurance premium, limits, deductibles) (RI)

Continuum of Approaches

Approach	Capital Charge	Capital Relief	Method
Basic	$K_g = EI \times \alpha$	$K_{RT,i} = P_i \times (1 - P_i / L_i) \times \lambda_i$	"Premium"
Standard	$K_{g,i} = EI_i \times \beta_i$	$K_{RT,p} = (L_p - P_p) \times CB_p$	"Limit"
IMA	$K_{g,i,j} = EI_{i,j} \times PE_{i,j} \times LGE_{i,j} \times \gamma_{i,j}$	$K_{RT,i,j} = P_{i,j} \times p_{i,j} \times LR_{i,j} \times \gamma^{RT}{}_{i,j}$	"Premium"
		$K_{RT,i,j} = (L_{i,j} - P_{i,j}) \times CB_{i,j}$	"Limit" (Aggreg.)
		$K_{RT,i,j} = \left(\min\left[\sqrt{N_{i,j}} \, l_{ee,i,j} ; L_{agg,i,j} \right] - \frac{1}{\sqrt{N_{i.}}} P_{i,j} \right) \times CB_{i,j}$	"Limit" (eel)
LDA	$K_g = F_{agg}^{-1}(0.99) - EL$		

Factors resembling actual bank specific risk situation
Factors based on historical industry wide data
Factors based on historical bank specific experience

Notation: for single BL, RC, perfect RT mapping, without Credit Risk Adjustment

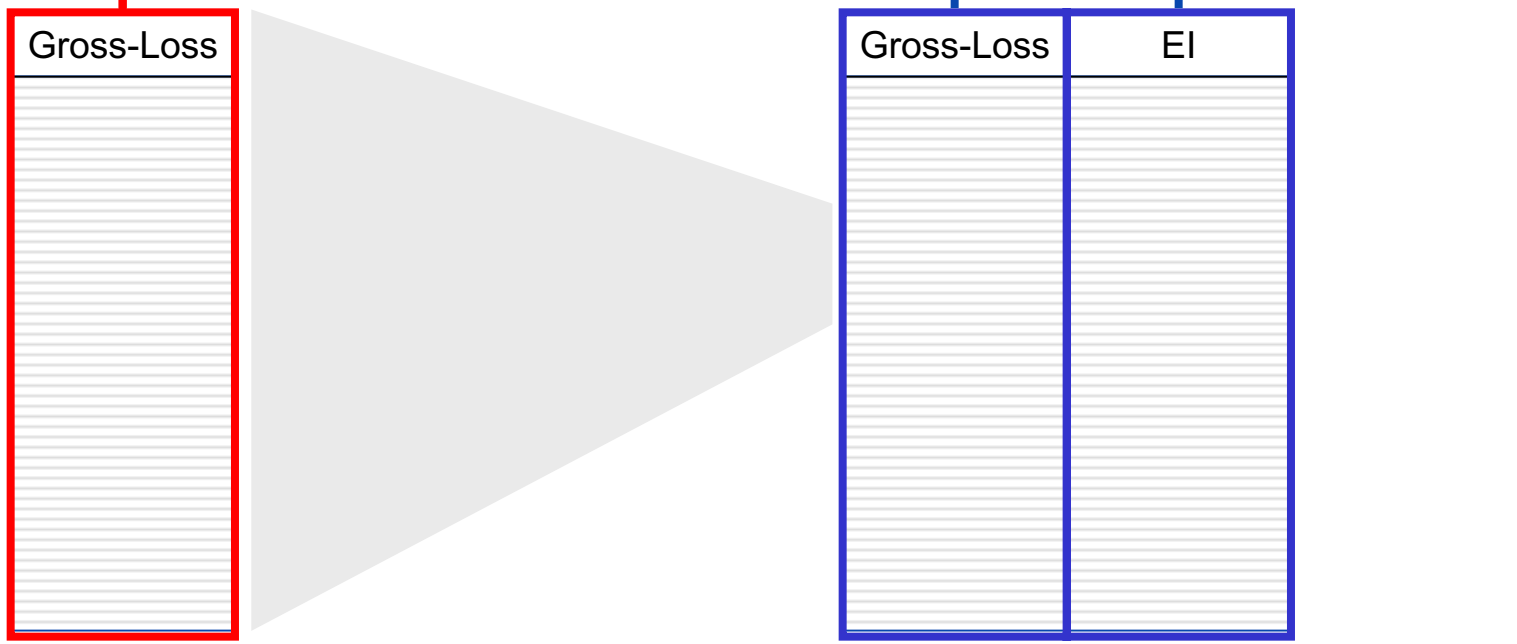
Calibration of Parameters

- “lower” approaches -

$$K_{g,i,j} = EI_{,j} \times PE_{i,} \times LGE_{,j} \times \gamma_{i,j}$$

EI

Regression analysis
MLE - Approach



Calibration of Parameters

- "lower" approaches -

$$K_{RT,i,j} = P_{i,j} \times p_{i,j} \times LR_{i,j} \times \gamma^{RT}_{i,j}$$

$$K_{RT,i,j} = \left(\min\left[\sqrt{N_{i.}}\, l_{ee,i,j}; L_{agg,i,j} \right] - \frac{1}{\sqrt{N_{i.}}} = P_{i,j} \right) \times CB_{i,j}$$

EI, P, L

Gross-Loss	Net-Loss

Loss	Net-Loss	EI	P	L

There are specific Advantages and Disadvantages for each Approach

"Lower" approaches

- facilitate the use:
  - work with lower amounts of data
  - "simple" formula approaches
- are conservative approaches as industry factors provide security margin

- lead to lower risk sensitivity and to higher capital cost
- do not enable full use of Risk Management opportunities

"Higher" approaches

- require high implementation efforts
- require substantial data management

  (incomplete or insufficient data may lead to wrong assessment of actual risk situation)

- lead to more risk sensitivity and to lower capital costs
- enable feedback to improve Risk Management
- enable to manage risks
- enable to optimize risk transfer options

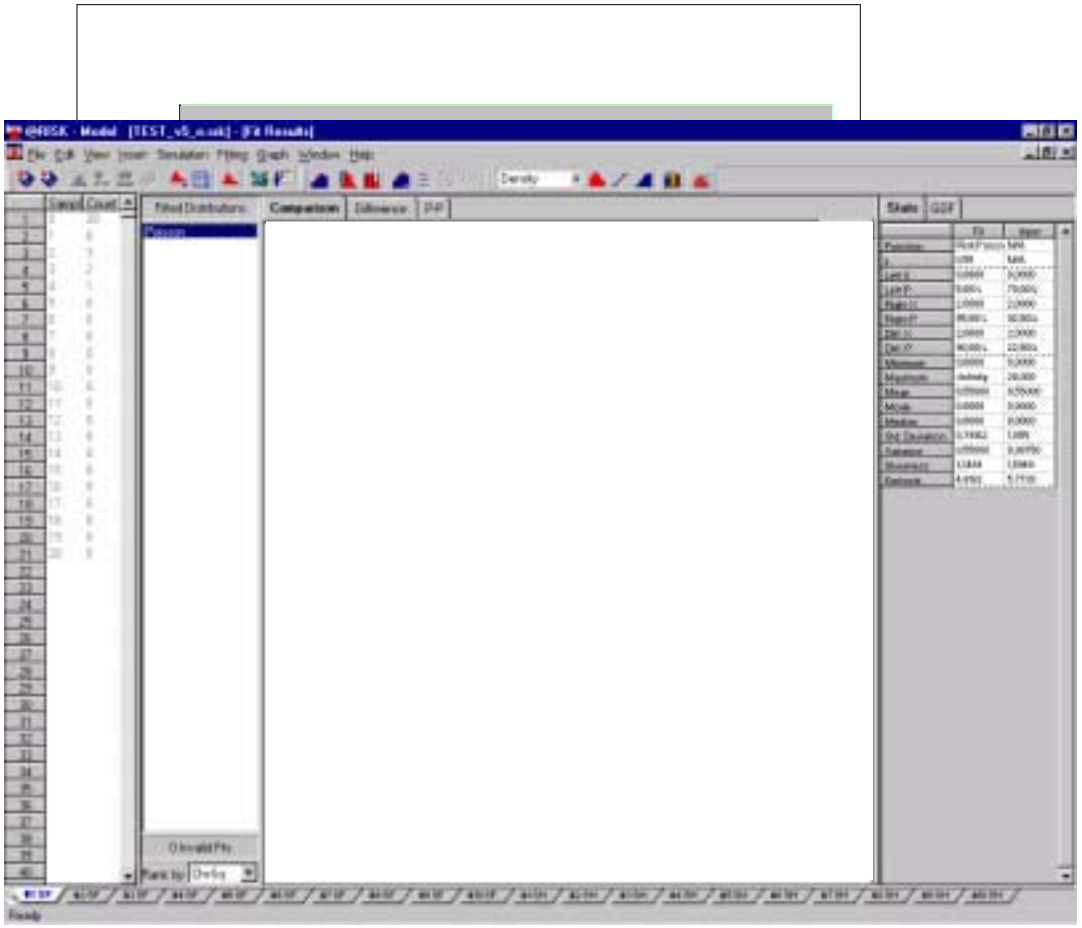
Frequency and Severity Distributions are generated

- Severity classes' equation:

$$border_i = \left(10^{\left(\frac{1}{c}\right)} \right)^{i+i_0}$$

- Frequency / Severity estimation fitting

- Accuracy of approximation by ChiSquare

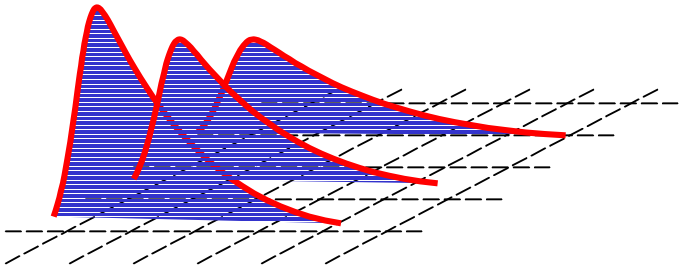


But still there are Gaps within the Landscape

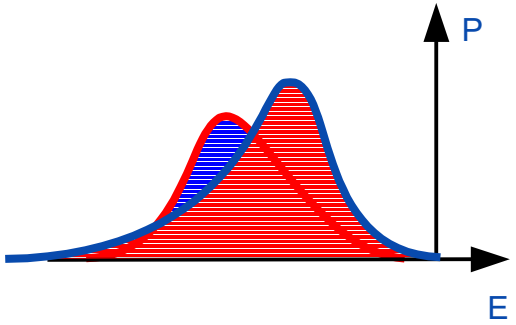
- Changing the risk map - Shaping the risk landscape -

- Inclusion of „external“ data
- Inclusion of worst case scenarios
- Inclusion of expert opinion
- Inclusion of risk transfer

Frequency and severity distributions will change



Mathematical Model

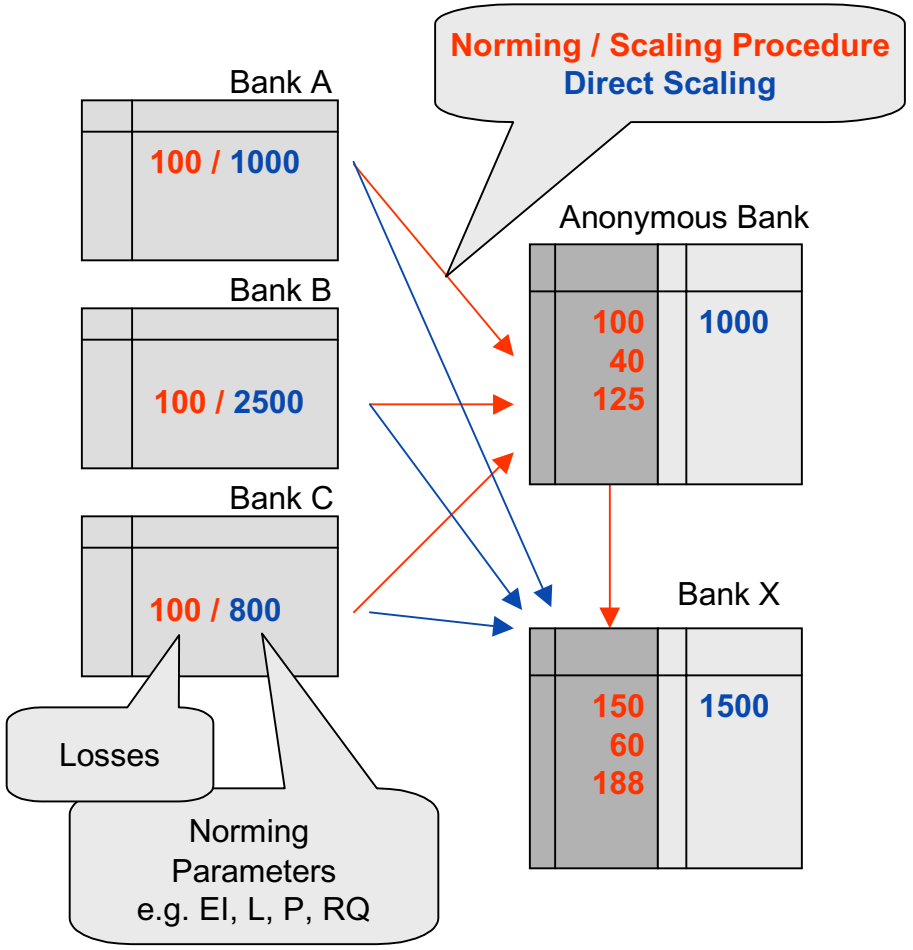


External Data have to be included using Scaling Techniques

Norming/Scaling equation:

$$X_{Bank.X} = X_{Bank.A} \cdot \left(1 + a \cdot \left(\left(\frac{EI_{Bank.X}}{EI_{Bank.A})}\right)^{b} - 1\right)\right)$$

- Two parameters (a, b) allow various relations
  - linear with different factors
  - positive and negative
  - exponential
- Possibility to "stack" multiple Norming/Scaling Parameters
- Possibility to generate "anonymous" losses and to merge data
- Parameter in relation to
  - Lines of Banking Business
  - Classes of Sizes of Banks

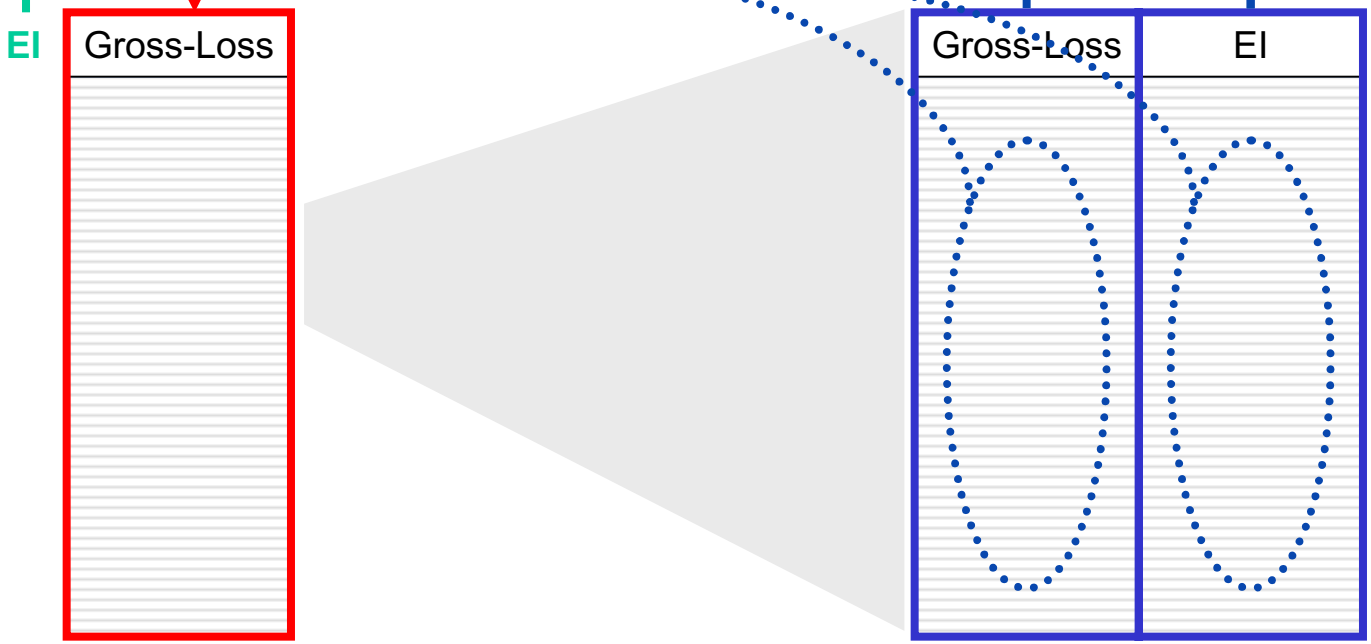


Calibration of Parameters

- Norming / Scaling -

$$X_{Bank.X} = X_{Bank.A} \cdot \left(1 + a \cdot \left(\left(\frac{EI_{Bank.X}}{EI_{Bank.A}}\right)^{b} - 1\right)\right)$$

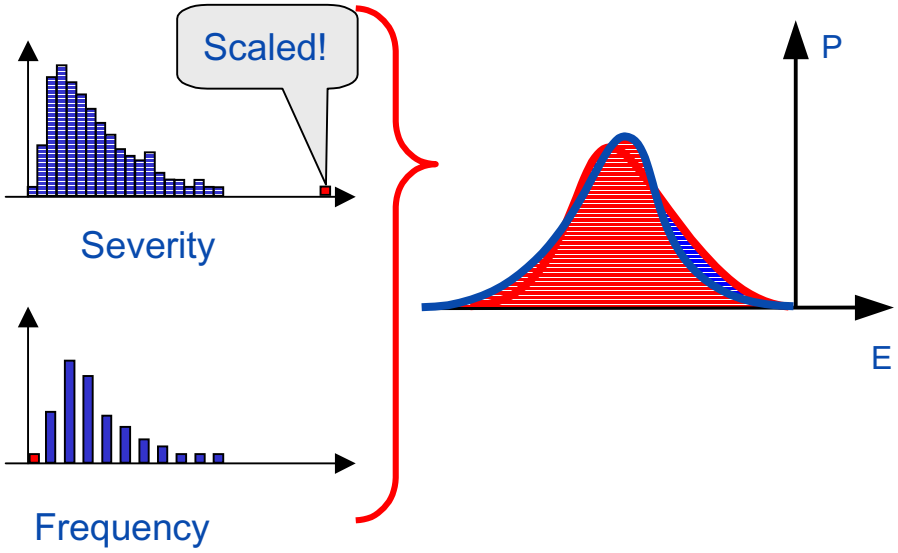
Regression analysis
MLE - Approach

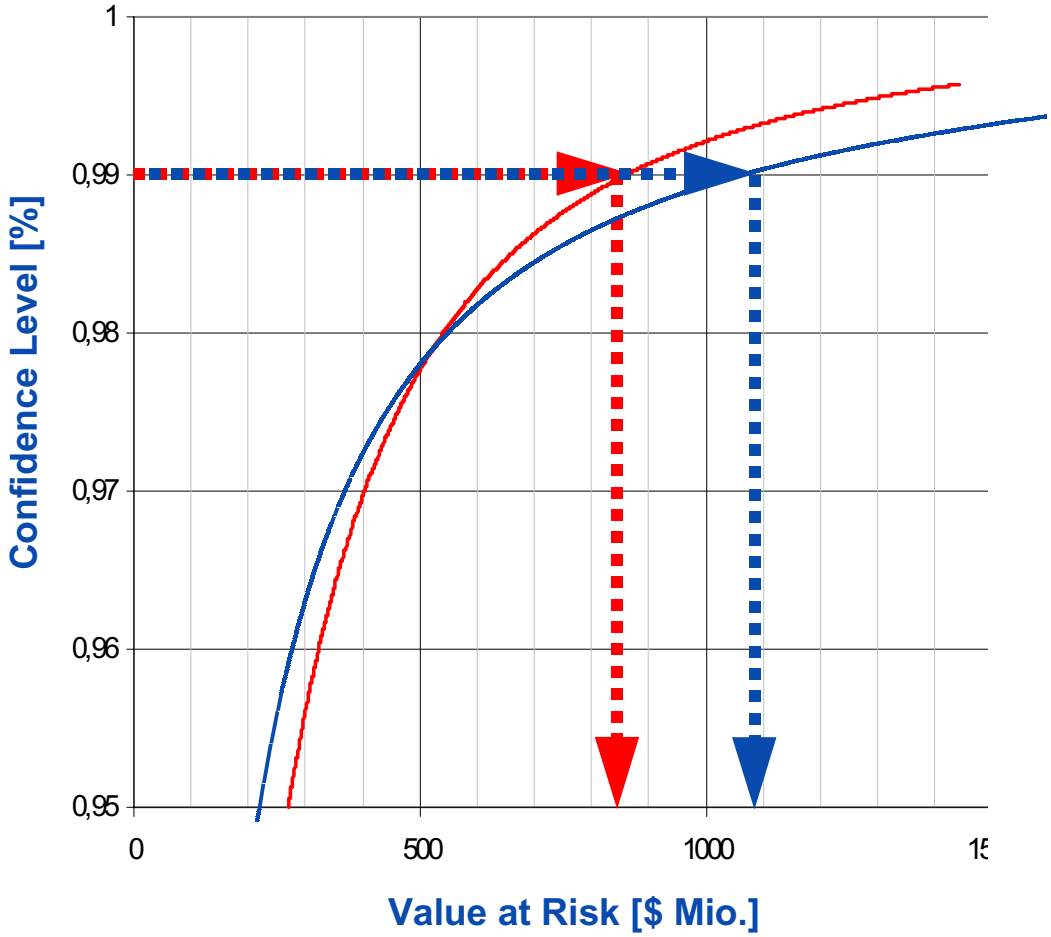


How to account for Worst Case Scenarios ?

- High Impact / Low Frequency Events -

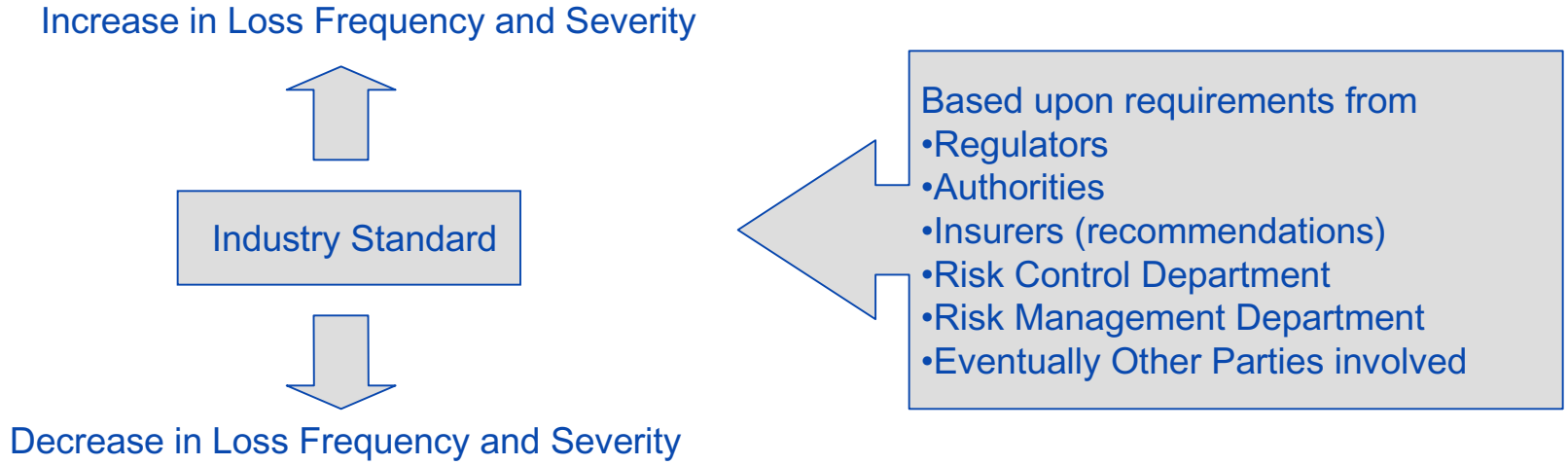
- Natural Disasters
- Bank of Credit&Commerce, 1991
- Barings, 1995
- .....





Risk Quality does have a Substantial Influence

- How to account for ? -



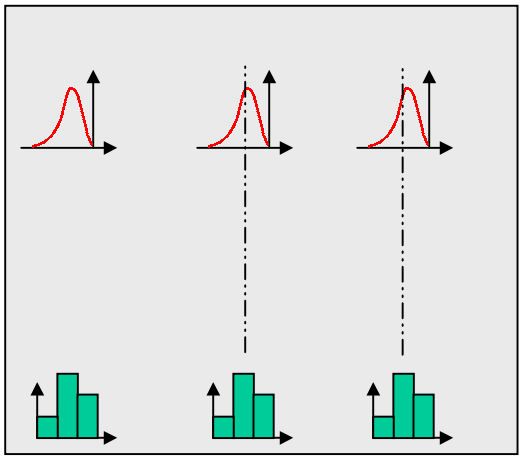
Sample: Fire Protection	Annual Probability of Occurrence

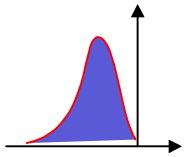
Source: Wuppertaler Berichte zum Brand- und Explosionsschutz Band 3

Adjustment and Aggregation of Distributions

- Overall Picture -

Convolution/Aggregation





Annual Loss Density Function
(per Peril/ Loss Cause, Business Line)

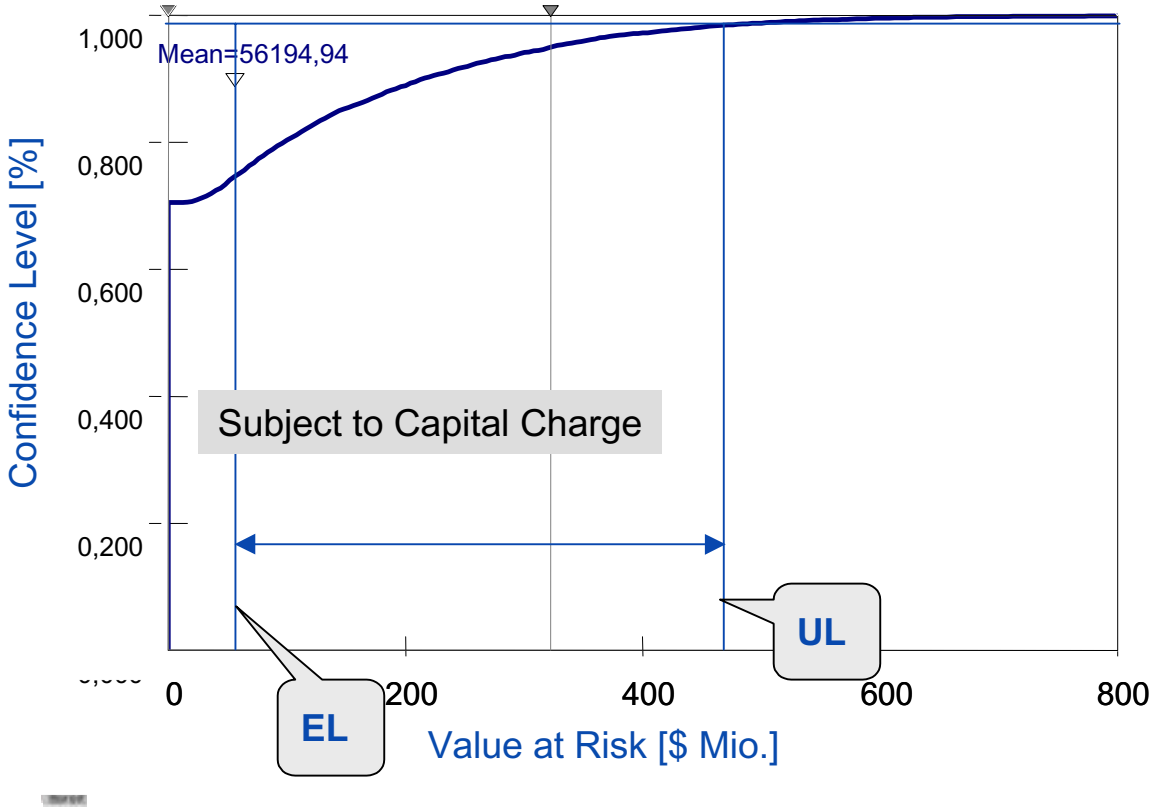
Scenario based assumptions using:
- Data Analysis approaches (empirically, parameterization)
- Expert Testimony (Delphi technique, ‚bets')
- Modeling (stochastic simulation, analytical model, Bayesian model, segmentation)

Quality Dimension	Adjustment Factors			
	Business	Business Line A	Business Line B	Business Line C
Management				
Organization				
Technical				
Controlling				
OR Man. Stand.				
Other				

Distribution	Type					
	Probability	Scaling		Scaling	Approved by	Last Update
Scenario A	Weibull		LogNormal	1,0	C,R	
Scenario B	Pare	1,5	Beta	1,0	C,I,R	
Scenario C	Poisson	1,0	LogNormal	1,0	C,I,R	

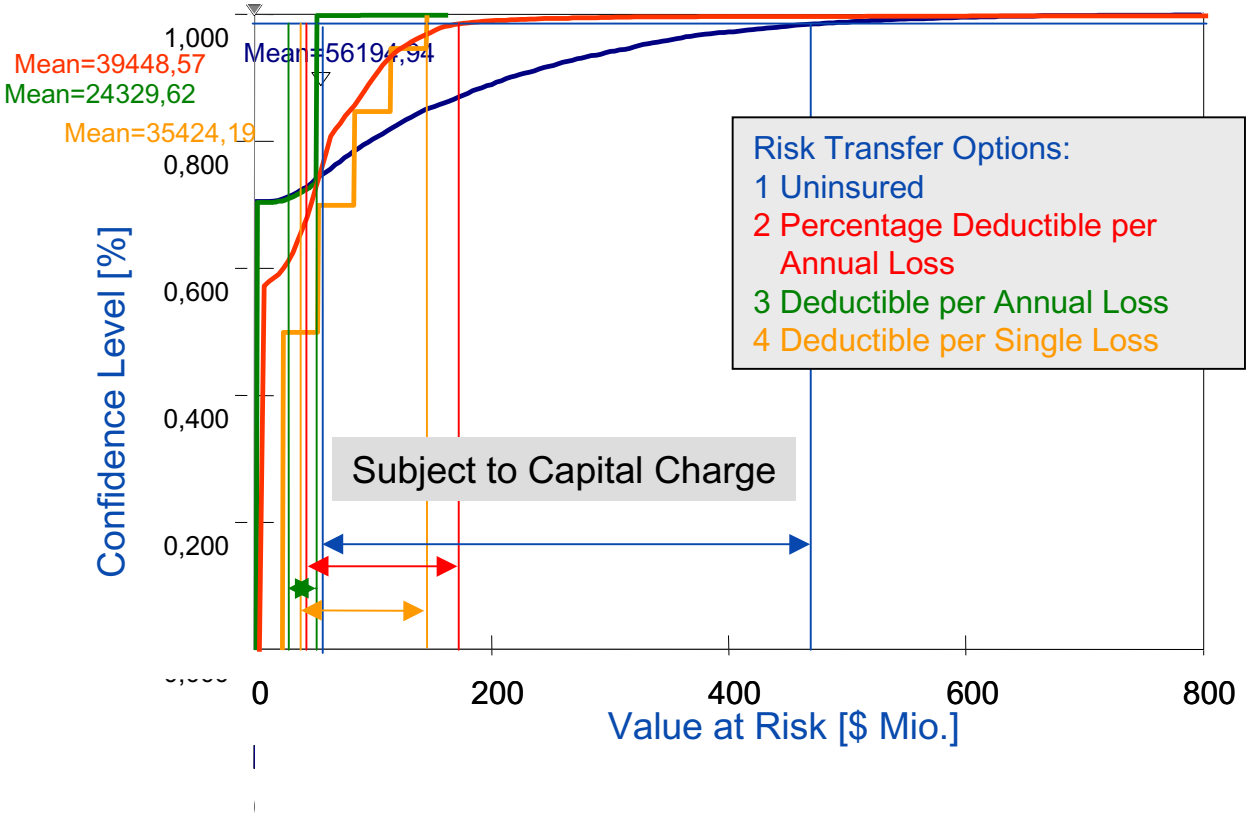
Aggregated Annual Loss Density Function (Single Risk / Gross)

- Calculated Capital at Risk (Gross)
- Confidence Level = 0,99 %
- Unexpected Loss
- Expected Loss set equal to Mean
- No Mitigation
- Per Single Risk
- Per Business Line



Aggregated Annual Loss Density Function (Single Risk / Net)

- Calculated Capital at Risk (Net)
- Confidence Level = 0,99 %
- Unexpected Loss being reduced
- Expected Loss set equal to Mean
- Mitigation
  - -->Prop. Insurance
  - -->Deductibles
  - -->Limits
- Per Single Risk
- Per Business Line

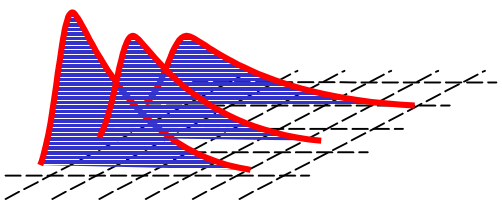


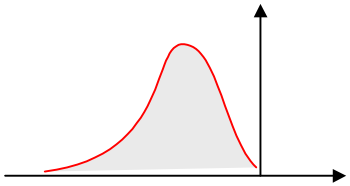
From single Risks to aggregated Risks and VaR (Gross and Net)

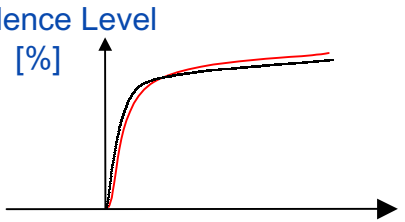
Risk Landscape

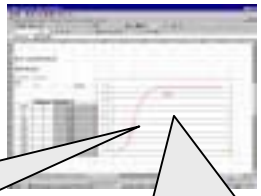
Aggregated Annual
Loss Density Function

Integrated Annual
Loss Density Function









Bottom up figures/function taking into account:
- loss prevention (avoidance, reduction)
- effective near misses systems
- self retention
- quality factors

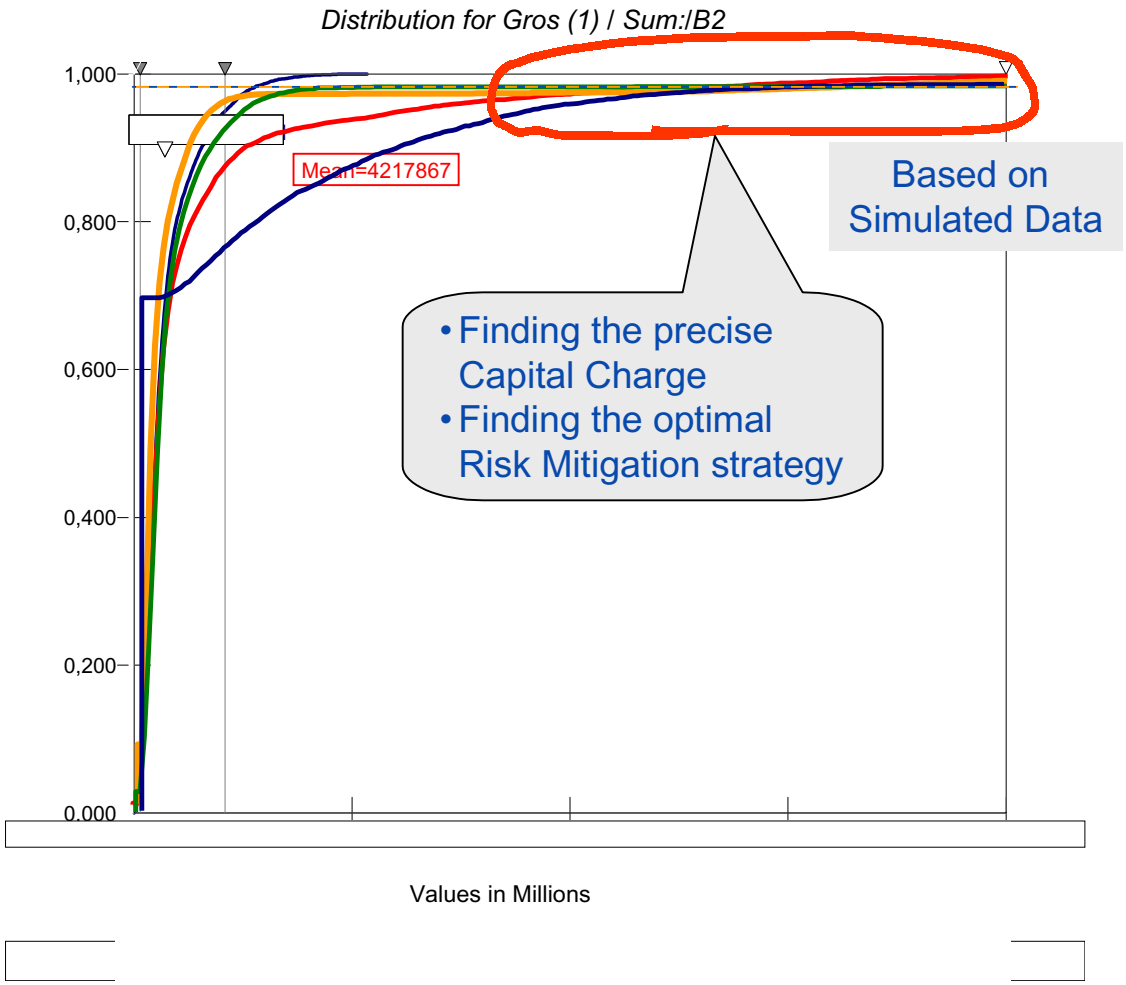
= gross

but excluding:
- mitigation by risk transfer

Operational Risk Capital
after mitigation/reduction
through risk transfer **= net**

Overall Distributions

- Calculated aggregated Capital at Risk (Gross/Net)
- Confidence Level = 0,99 %
- Unexpected Loss
- Expected Loss set equal to Mean
- Mitigation on Single Risk Basis:
  - --> Proportional Insurance
  - --> Deductibles
  - --> Limits
- Mitigation on aggregated Risk Basis:
  - --> Stop Loss System
  - --> Deductible
  - --> Limit
- Per Business Line



Summary

- Loss Distribution Approach -

The Loss Distribution Approach is/will be a feasible solution to:

- **calculate operational risk capital including capital charge with a high degree of risk sensitivity**
- **integrate risk management quality and best practice standards into the overall process and therefore offer the opportunity to grant benefit for "good" risk management**
- **design risk mitigation by insurance as effective and comprehensive as possible**

Summary

- **Discussion on Taxonomy and Data Collection (Standards) is coming close to an end: Final summit of involved parties (regulators, banks & insurers) and final approval through regulators suggested**

- **It is important and possible to reflect the effects of risk management and risk transfer in the risk landscape, henceforth in the capital charge**

- **Discussion on approaches to calculate capital charge and relief: Further analytic, scientific and practical work as well as open exchange of ideas needed.**

- **LDA still regarded as most risk sensitive approach:**
  Prototypes show feasibility - Pilot implementations will prove practicability