

# Innovations in Integrating Operational Risk Measurement and Management

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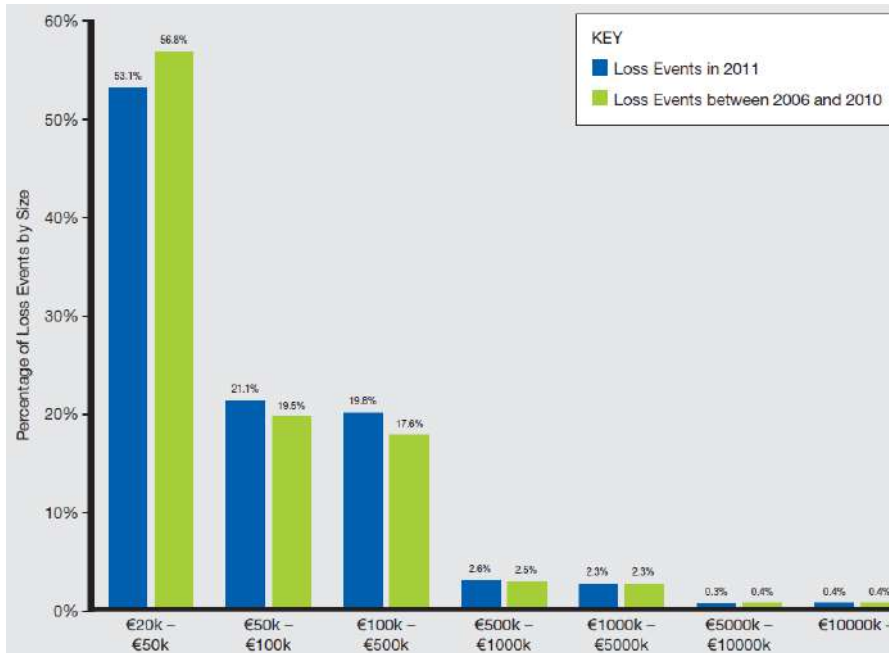




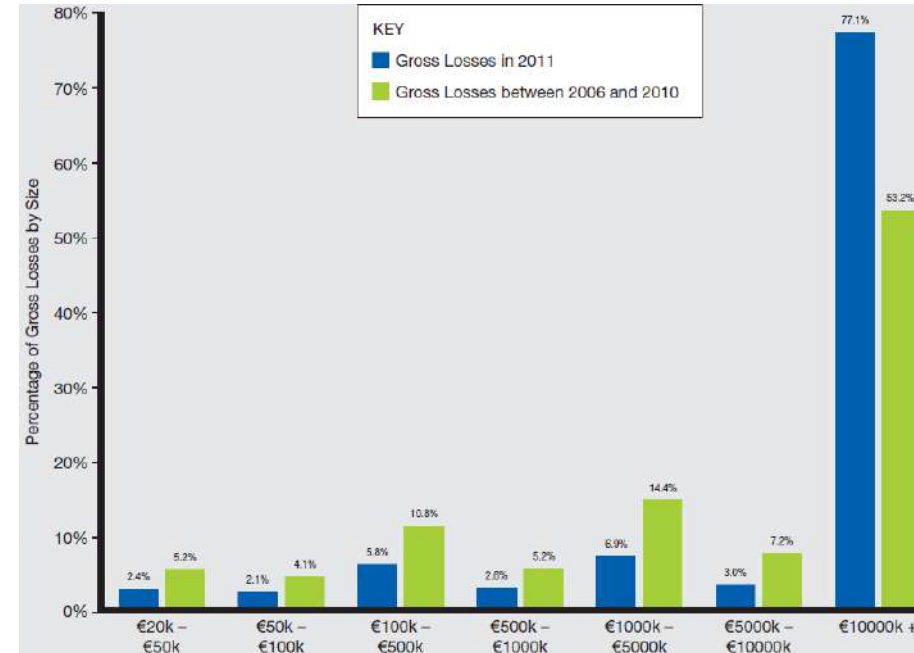
# Nature of Operational Risk Losses

## Global Banking Industry

Distribution of Number of Events by Size (ORX)

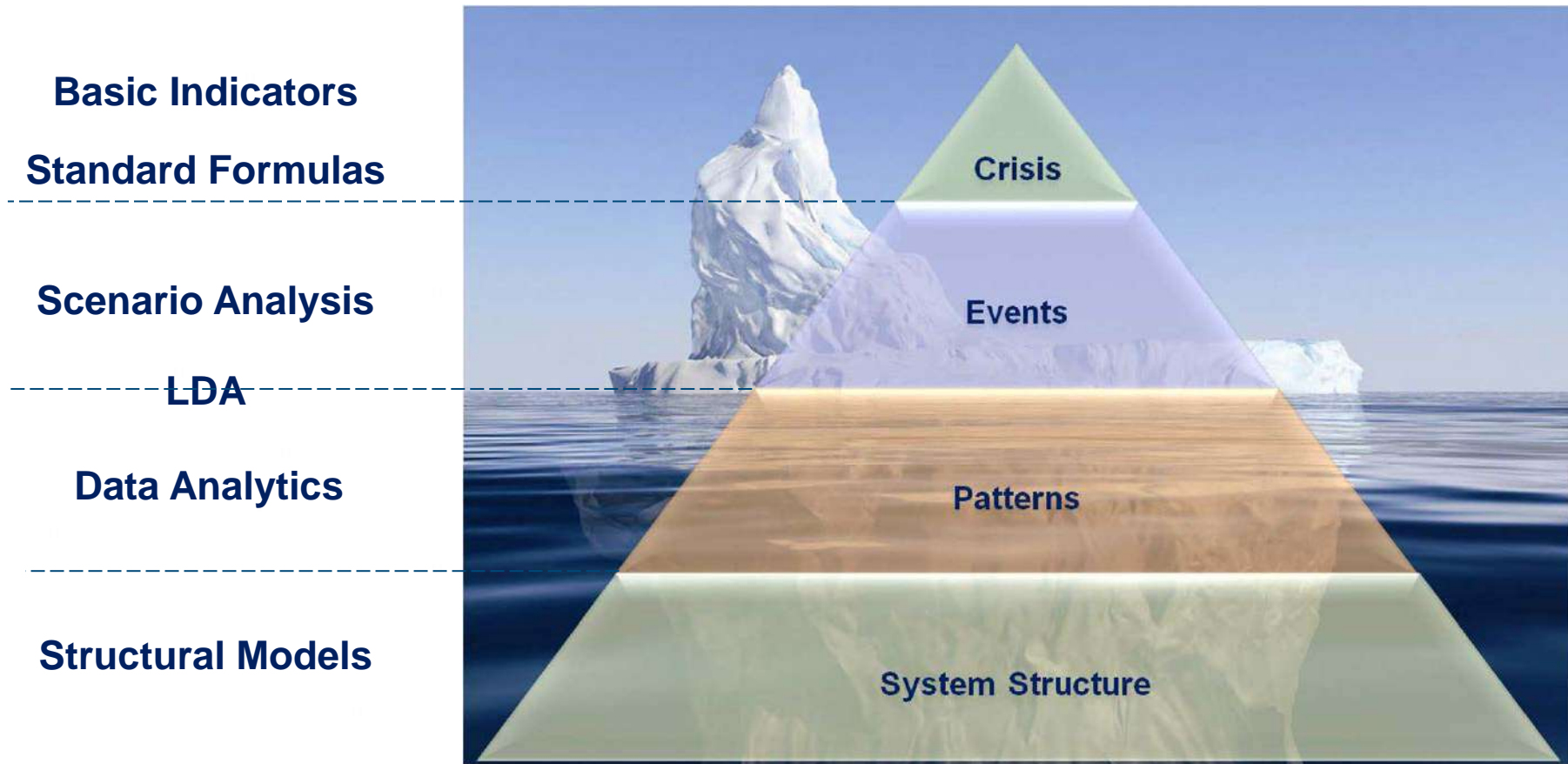


Distribution of Total Gross Loss by Size (ORX)



*Severity and Likelihood are not independent  
 → Traditional actuarial approaches don't work*

# Modelling Framework Choices



# Basic Indicator and Standard Formulas

Operational risk capital scales in line with broad business metrics such as:

- Gross income
- Premiums, claims, expenses
- Liabilities, Assets / AUM
- Capital

Assumes stable loss generation mechanisms (LGM)

Simple, transparent, cheap, but... main problem is that it isn't linked to the LGM itself !

- Rough proxy only
- No incentive to manage op risk
- Enables gaming of the system

Country / Sector	Indicator	Factor (indicative)
Global, Basle II	Gross income	12% to 18%
EU, Solvency II	BSCR, premiums, liabilities, expenses	Capped at 30% of BSCR + 25% UL expenses
Australia, LAGIC	Premium, liabilities, claims	Varies for Life vs General
Japan, SSR	"BSCR"	3% if P&L < 0 2% if P&L > 0
South Africa, SAaM	BSCR, premiums, liabilities, expenses	Varies for Life vs General; Floored at 30% of BSCR + 25% UL expenses
Taiwan, RBC	Premiums, AUM	0.5% life, 1% annuity, 1.5% other, 0.25% AUM
USA, Europe ex EU, Other Asia, Russia, NZ	None!	

# Scenario Analysis

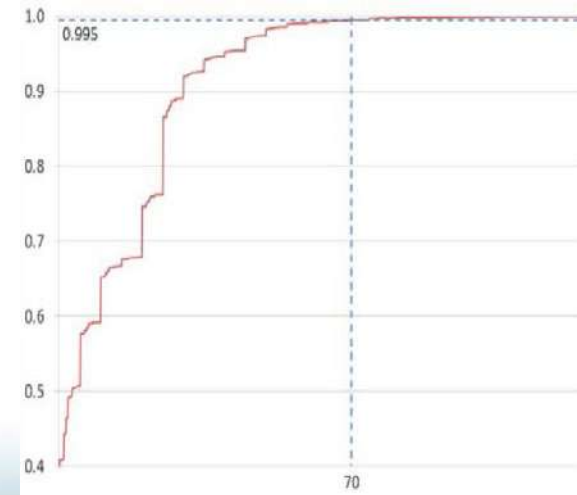
*Common method currently used*

*Forward looking and transparent, but suffer from:*

- *selection bias*
- *the when to stop problem*
- *human bias (e.g. 1 in 1000 event?)*
- *rubbery inter-relationship assumptions*
- *lack of uncertainty*
- *no allowance for complexity*
- *no ability to use inference*

1. Hypothesize loss severity and likelihood of possible scenarios
2. Generally assume scenario independence, use generalized binomial distribution to estimate loss distribution and thus capital (VaR / CTE).
3. Or assume linear dependence, use correlations

SCENARIO	SEVERITY (M)	LIKELIHOOD (P.A.)
1	5	5.00%
2	10	1.00%
3	1	3.00%
4	10	1.00%
5	10	1.00%
6	10	5.00%
7	20	5.00%
8	5	5.00%
9	5	5.00%
10	30	0.50%
11	25	0.25%
12	75	0.10%
13	10	0.10%



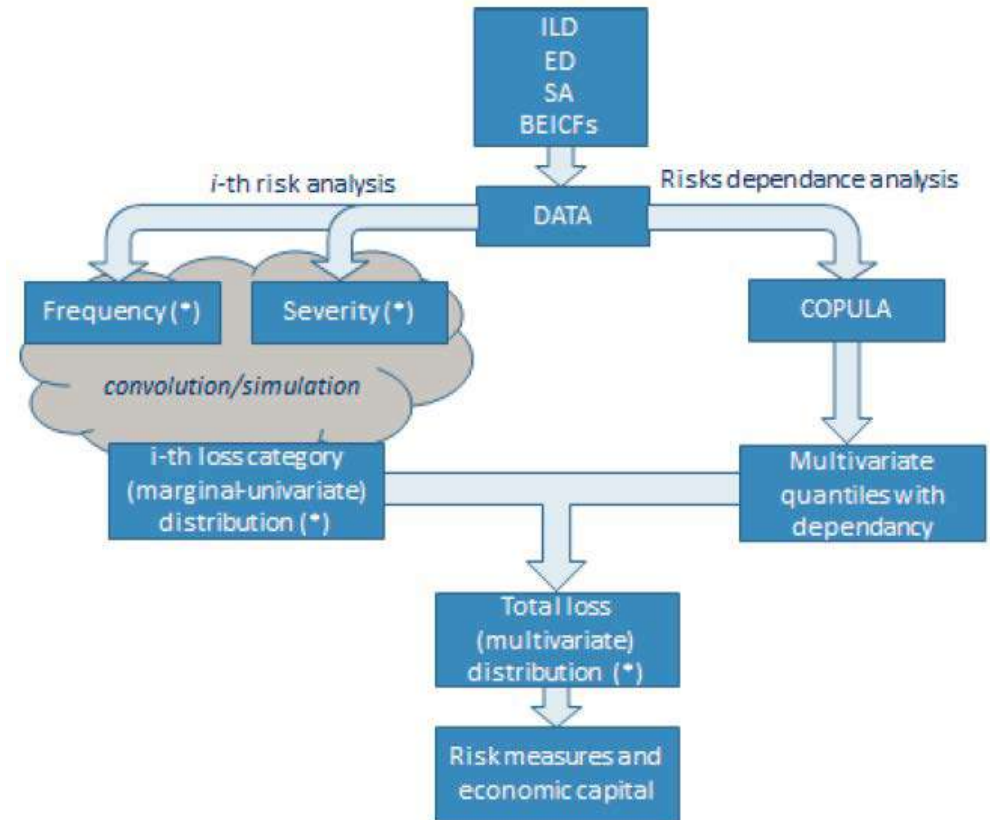
# Loss Distribution Approach (LDA)

Basel II allows for the use of an Advanced Measurement Approach (AMA) with regulatory approval.

Current common practice in leading global banks and bankassurers

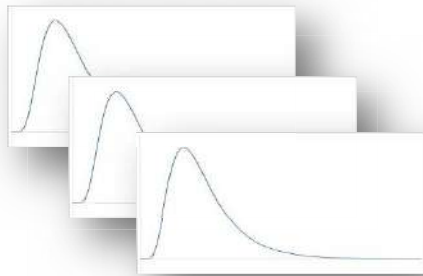
Distribution calibration leverages multiple data sources:

- Internal loss data (ex-post)
- External loss data (ex-post)
- Scenario analysis (ex-ante)
- Business environment and internal control factors (ex-post, current, ex-ante)

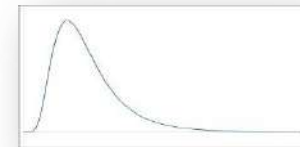


# LDA Challenges

- Typically simulates the compounding effect of variation and uncertainty through statistical models with dependency structures
- Typical to assume independence between frequency and severity
- LDM being modeled is a complex adaptive system, which exhibit emergence and adaptation (non-stationary).
  - Historical data therefore irrelevant for many behaviours



$$\rho = \begin{pmatrix} 1 & \cdots & \rho_{1n} \\ \vdots & \ddots & \vdots \\ \rho_{n1} & \cdots & 1 \end{pmatrix}$$



*Models are not often used to understand “modal” behaviours...they are used to understand extremes. But the mechanisms of these behaviours are likely to be different to those seen often and are likely to adapt over time. Emergent behaviour requires us to focus on interactions, but these modelling methods artificially set these.*



# Unravelling Operational Risk

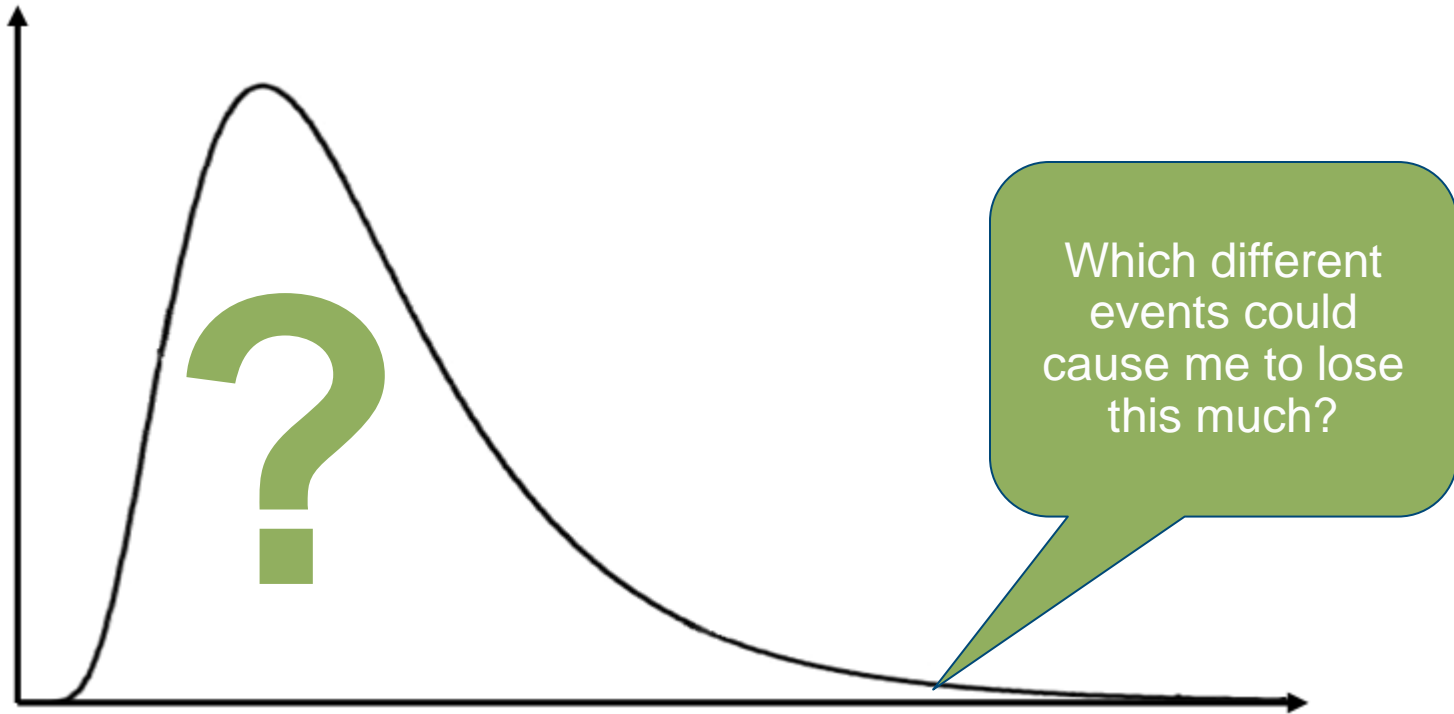
*Bridging the gap between “modelling” and “managing”*

I just need a number for my Op Risk capital



I just want to manage my operational risks

# Prediction $\neq$ Explanation

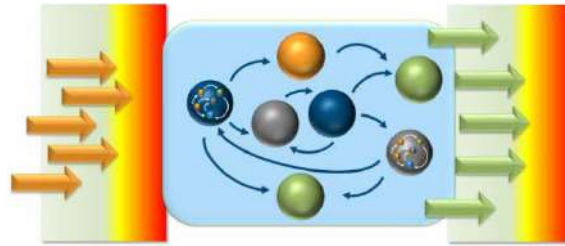


# Segmentation by Loss Generation Mechanism

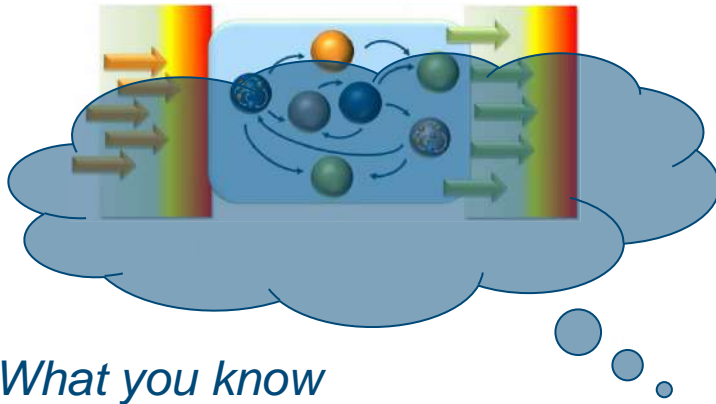
- Highly heterogeneous
- Is the system generating the loss stable or complex adaptive?

Industry	Low Severity High Likelihood	Medium Severity Medium Likelihood	High Severity Low Likelihood
Banking	ATM failures	Online security breach	Rogue trader
Insurance	Claims processing	Regulatory compliance failure	Mis-selling Mis-pricing
Mining	Transport service interruption	Environmental contamination	Mine collapse
Energy	Meter reading errors	Environmental contamination	Oil spill Gas plant fire

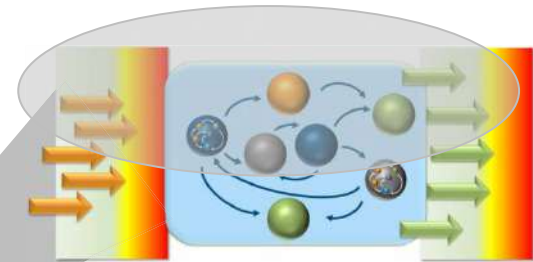
# Paths to Enlightenment



*The System*



*What you know*



*What you see*



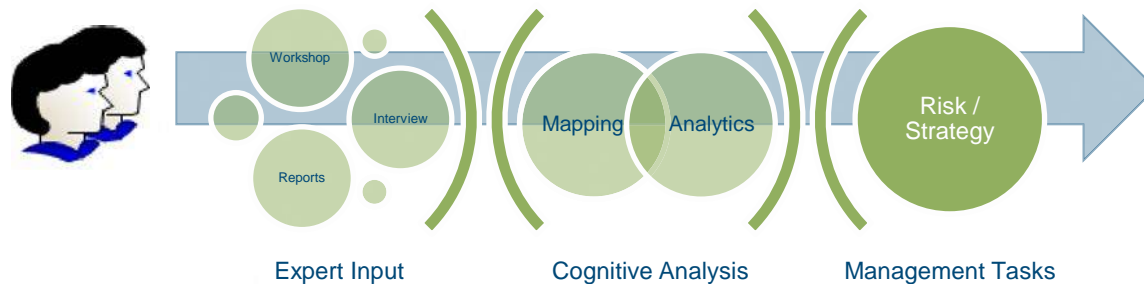
# Cognitive Analysis

*Input is captured through discussion with experts and key stakeholders.*

*Workshops or interviews permit them to explain their understanding of complex business dynamics.*

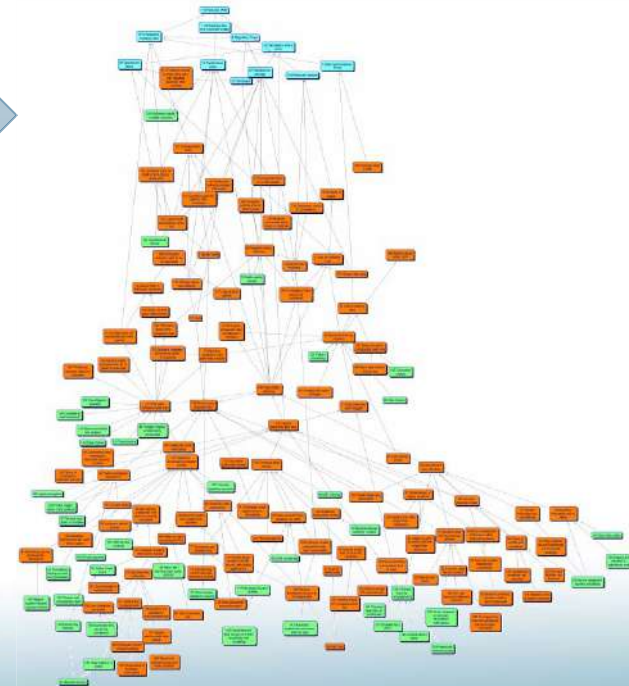
*Logical and structured nature of analysis provides input to a wide range of risk management tasks.*

*Analysis is particularly helpful for describing “hard” risks which involve many factors and complex adaptive behaviours.*



*Information is structured as a cognitive map and analysed using a combination of mathematical and psychology techniques.*

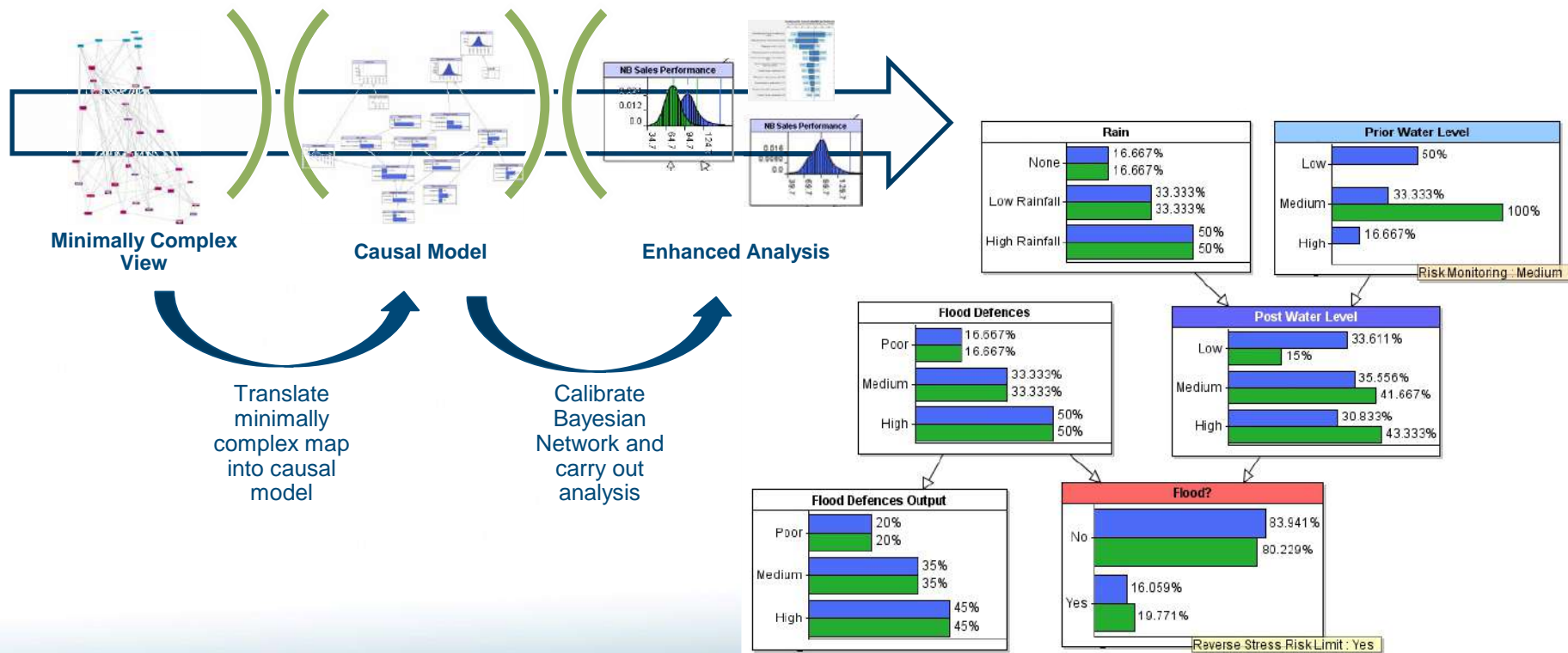
*Key features and dynamics objectively and rapidly determined.*



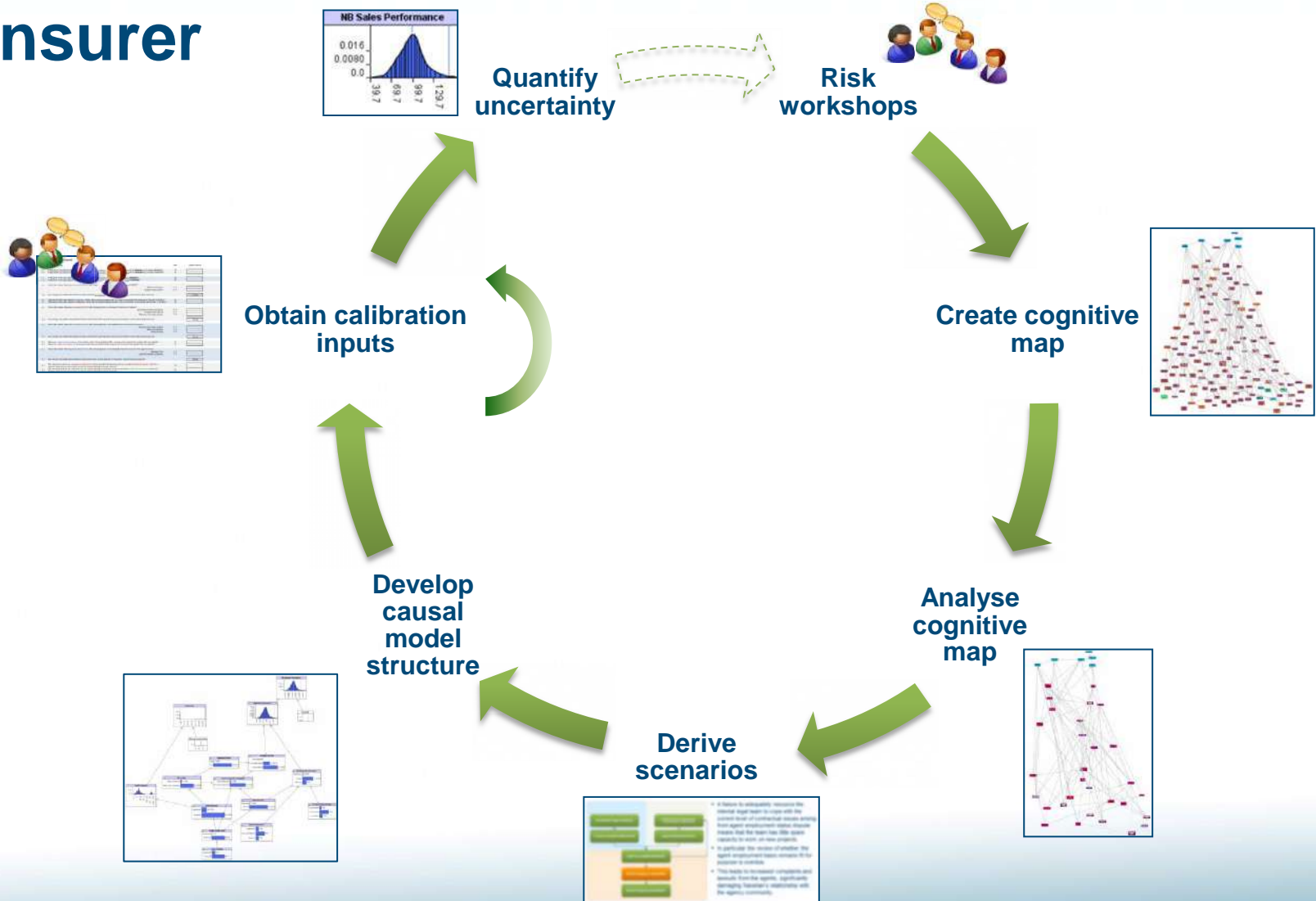
# Causal Modelling with Bayesian Inference

## Prediction with Explanation

Causal modelling techniques can be used to formally demonstrate how indicators flow through to the business outcomes being studied. Framework retains the dynamic links between causes and losses so risks are viewed in context and incorrect conclusions from silo-thinking are avoided.



# Sales Risk Case Study – Leading Taiwanese Insurer



# Risk Workshops

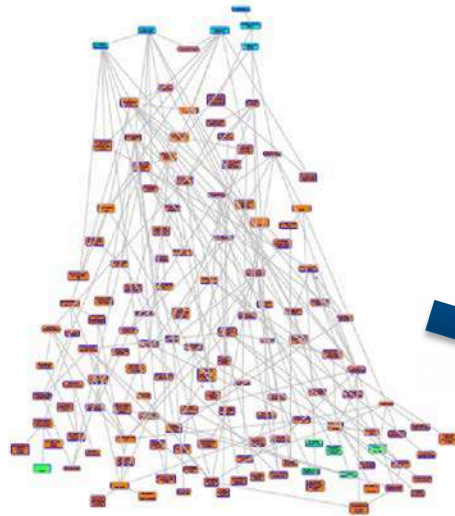


- Risk Workshops - *high level discussions centred around the objectives of the business and what could cause the business to fail*
  
- Case study objectives:
  - Explore the different factors which may improve or damage new business performance; and
  - Identify the types and sources of operational failure associated with distribution
  
- Three separate workshops facilitated by Milliman consultants:
  - Bank distribution
    - *simplicity of products, relationship between insurer and bank, strength of promotion*
  - Sales agent distribution
    - *agent retention, agent training, sales fraud, mis-selling*
  - Legal and compliance
    - *agent contracts, legal resourcing, regulatory action*



# Codifying Business Intelligence

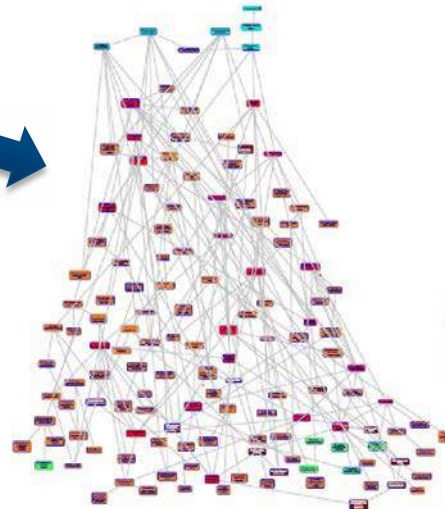
## Cognitive Mapping & Analysis



1. Detailed notes from each workshop used to translate the risk discussion into cognitive maps

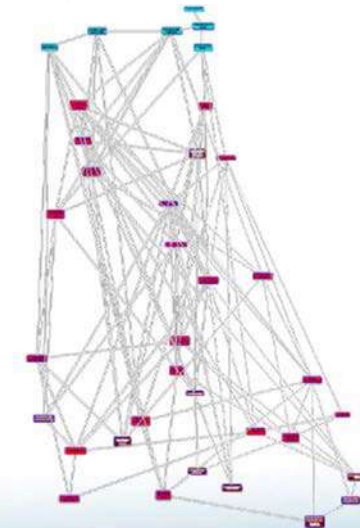
- separate cognitive maps merged together to give complete description of risk profile

2. Connectivity analysis identifies key features of risk system



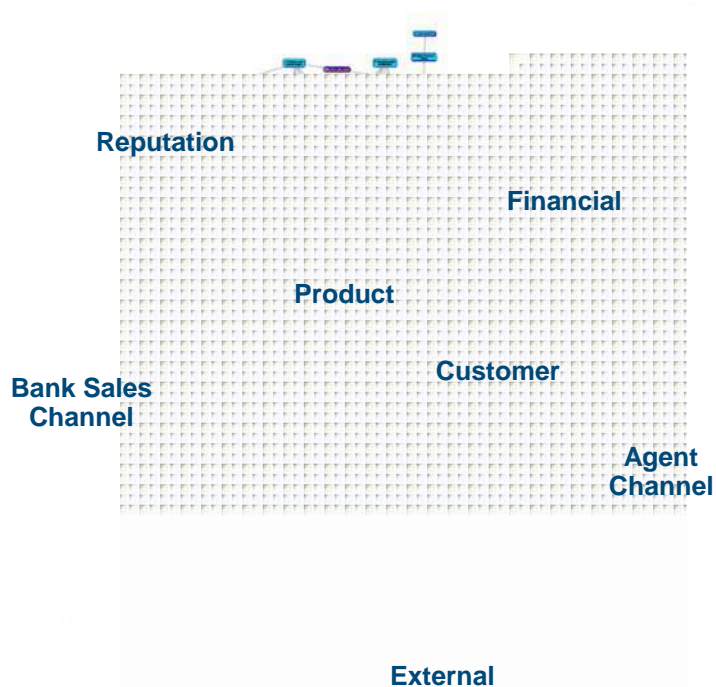
3. Collapsed view provides a 'minimally complex' description of the system

- Retains the key features necessary to understanding drivers of uncertainty



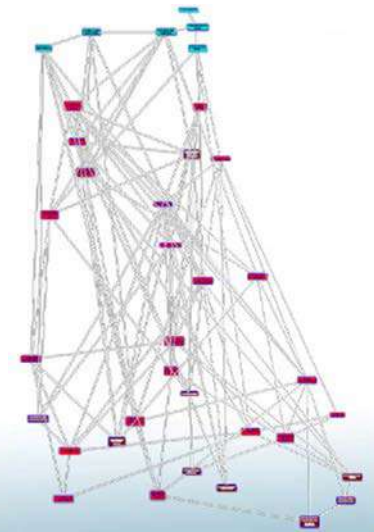
# Identifying Critical Drivers

*Highly connected drivers across the various silos*



- Structure of the map broadly reflects the key areas discussed within the workshops
  - Financial, Agent Channel, Product, Customer, Reputation, External, Bank Sales Channel
- Visually represents the distinct risk profile of each sales channel

Cognitive analysis identified key interactions between the risk profiles







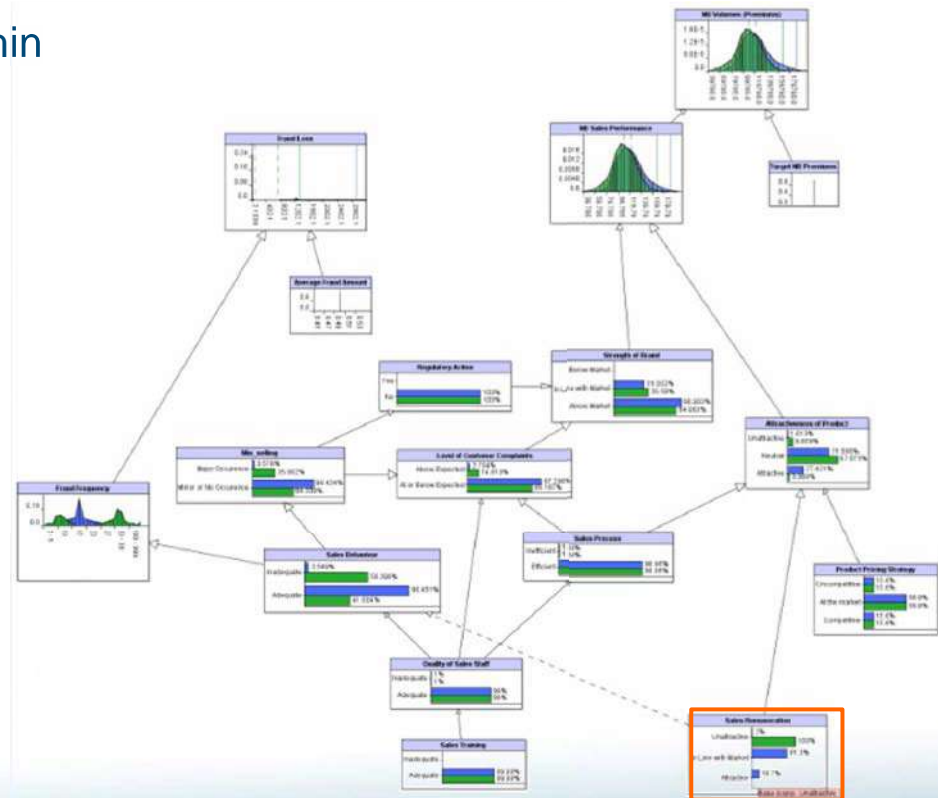


# Structured Scenario and Stress Tests

*Assess / compare materiality of various management actions*



- Scenarios selected by client quantified within the model using “What if?” analysis.
- Sales Remuneration for Agents set to be **100% Unattractive**
- Agent NB Volumes decrease
  - Mean: \$X to \$Y
- Total NB Volumes decrease
  - Mean: \$X to \$Y

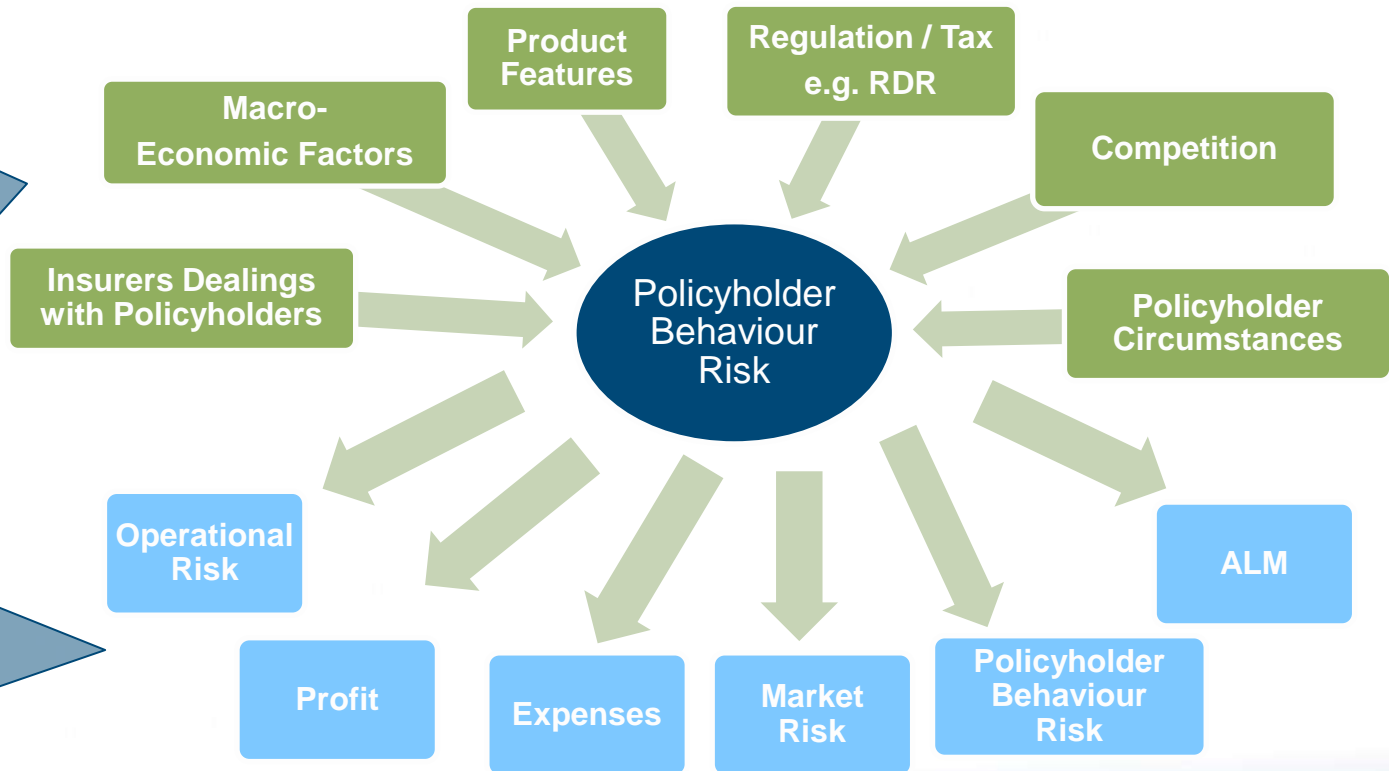


# Understanding policyholder behaviour

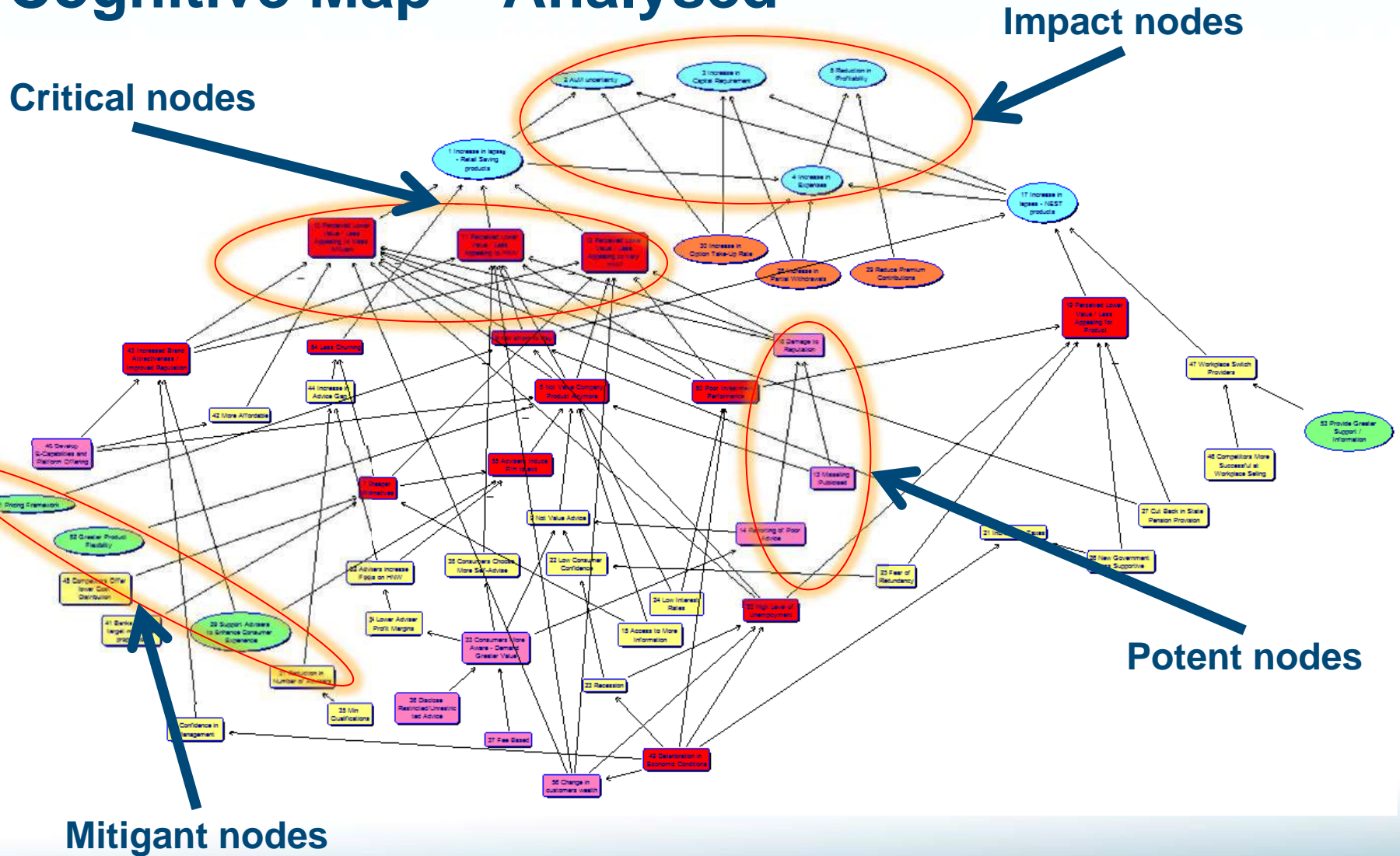
## Causes and Consequences

Many (interacting) influences over the behaviour of policyholders suggests that the risk will need to take into account a good deal of complexity to be well modelled.

Interaction with several key areas of the economic balance sheet suggests that policyholder could be a potent driver of uncertainty in level of own funds.



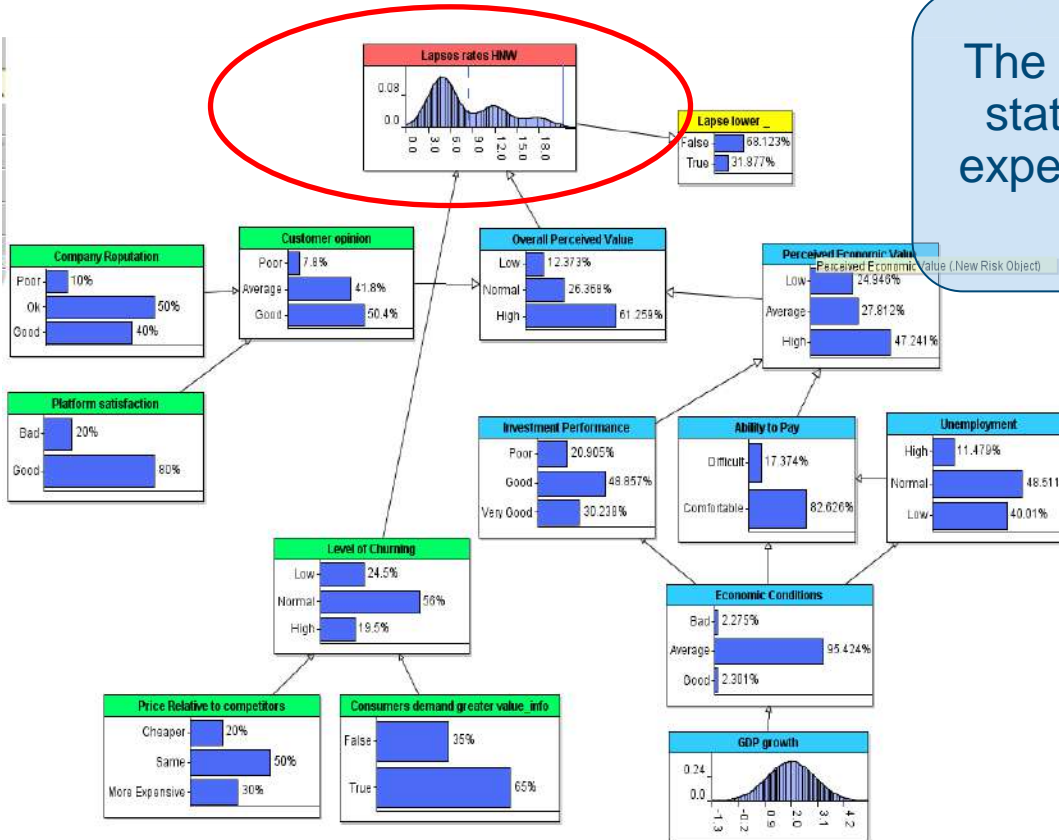
# Cognitive Map – Analysed





# Modelling Approaches –

## Bayesian Network Model



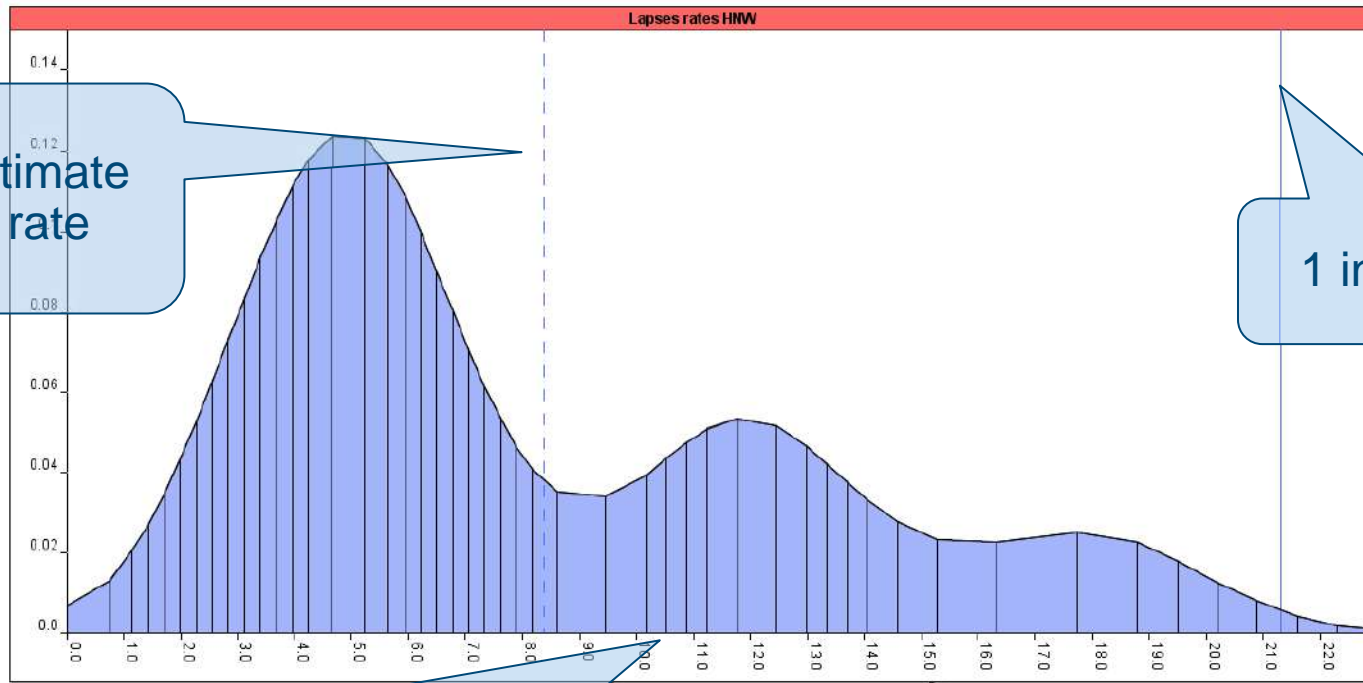
The model can be calibrated using the statistical data that is available - and expert judgement of the people closest to the action.

Expert judgement is expressed in terms:

- What would happen if this event occurred
- How certain they are about different outcomes from the scenario.

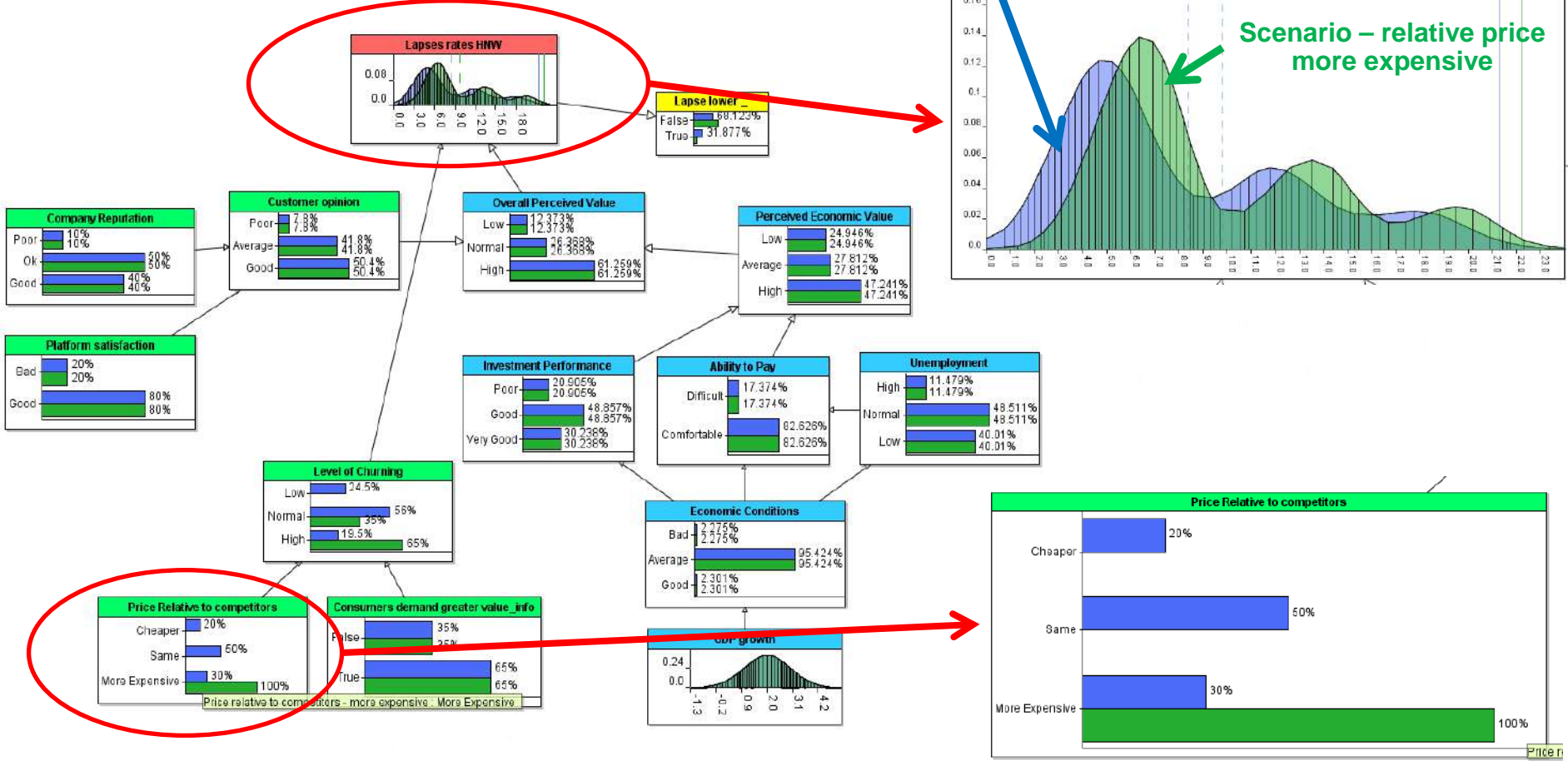
# Modelling Approaches –

## Overall Lapse Rate Distribution

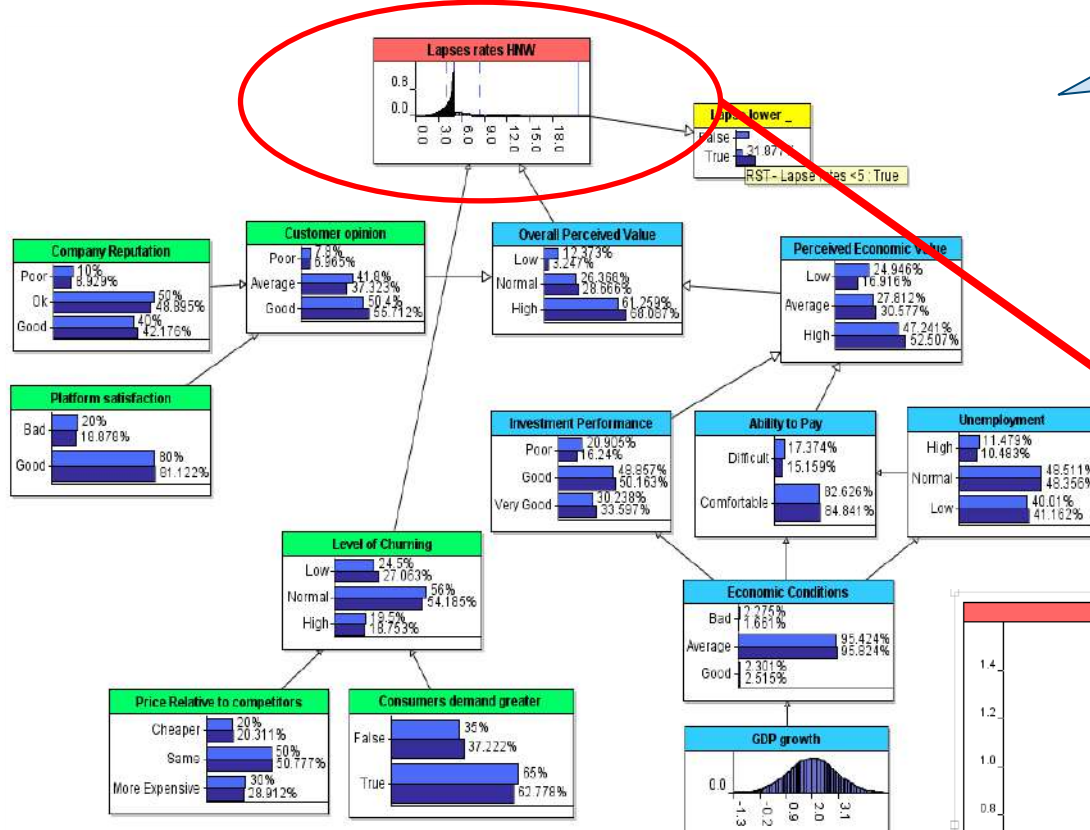


- The result of the model is the density distribution function of the lapse rates
- The model can be calibrated differently for different products
- The model can be recalibrated when environment changes

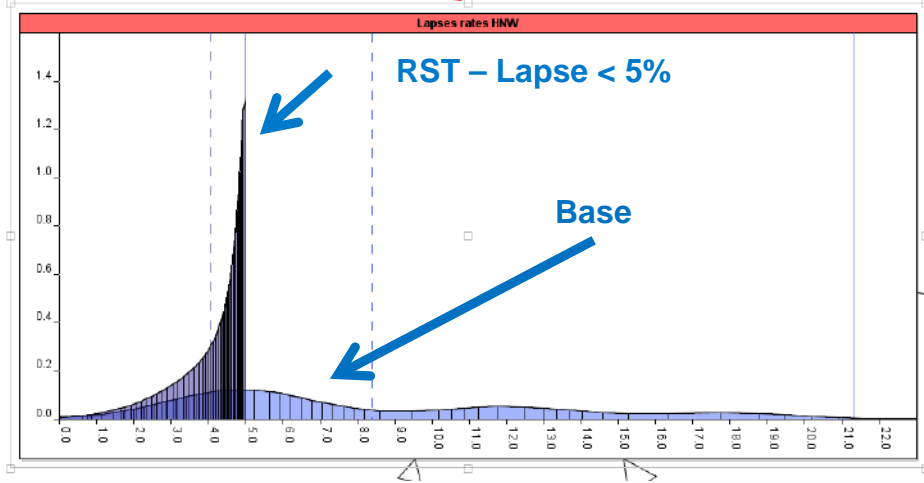
# Modelling Approaches – Scenario ‘Relative Price more Expensive’



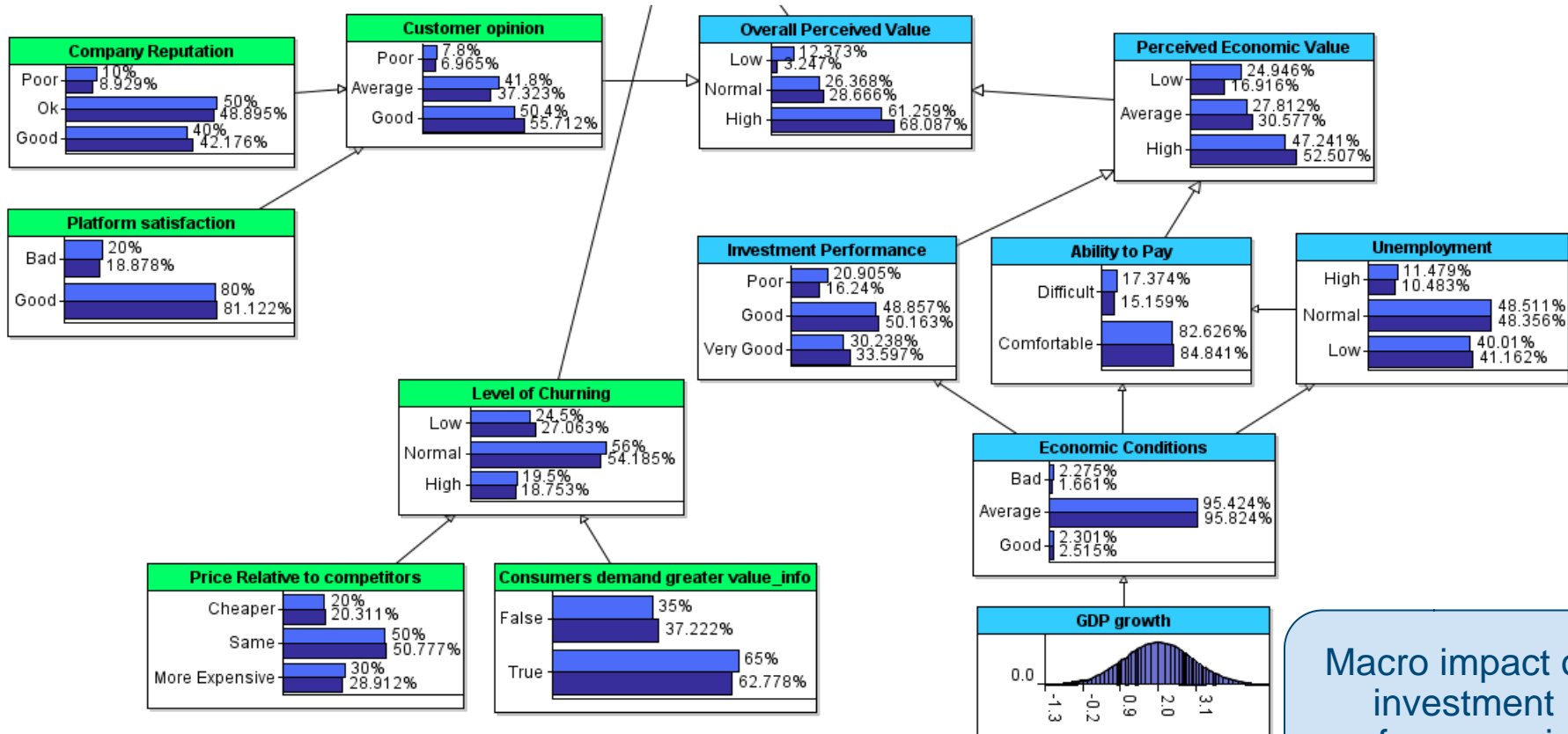
# Modelling Approaches – Reverse Stress Testing



RST – the state of the world most likely to lead to max lapse rate of < 5%



# Modelling Approaches – Reverse Stress Testing



Platform and company reputation has greater impact than 'relative price to competitors'

Macro impact on investment performance is a material driver



# Selection of Clients Using Complexity Science



Quasi-governmental organisation providing protection to pension members of UK private schemes



Major Australian life insurer



Consolidator of closed life assurance books focusing on the UK and Ireland



Major Multinational Insurer. Is the UK's largest insurance company



One of Australia's top 4 banks, also operates in New Zealand, Asia, UK and the US



One of New Zealand's largest electricity generators and retailer to the domestic and business markets



Specialist UK Insurer focusing on enhanced (impaired life) annuities



Taiwanese life insurance company



Specialist UK Insurer focusing on enhanced (impaired life) annuities



Australian Asset Management Firm

# Thank You!

## Questions?

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