The Actuarial Profession
making financial sense of the future

Life Conference and Exhibition 2011
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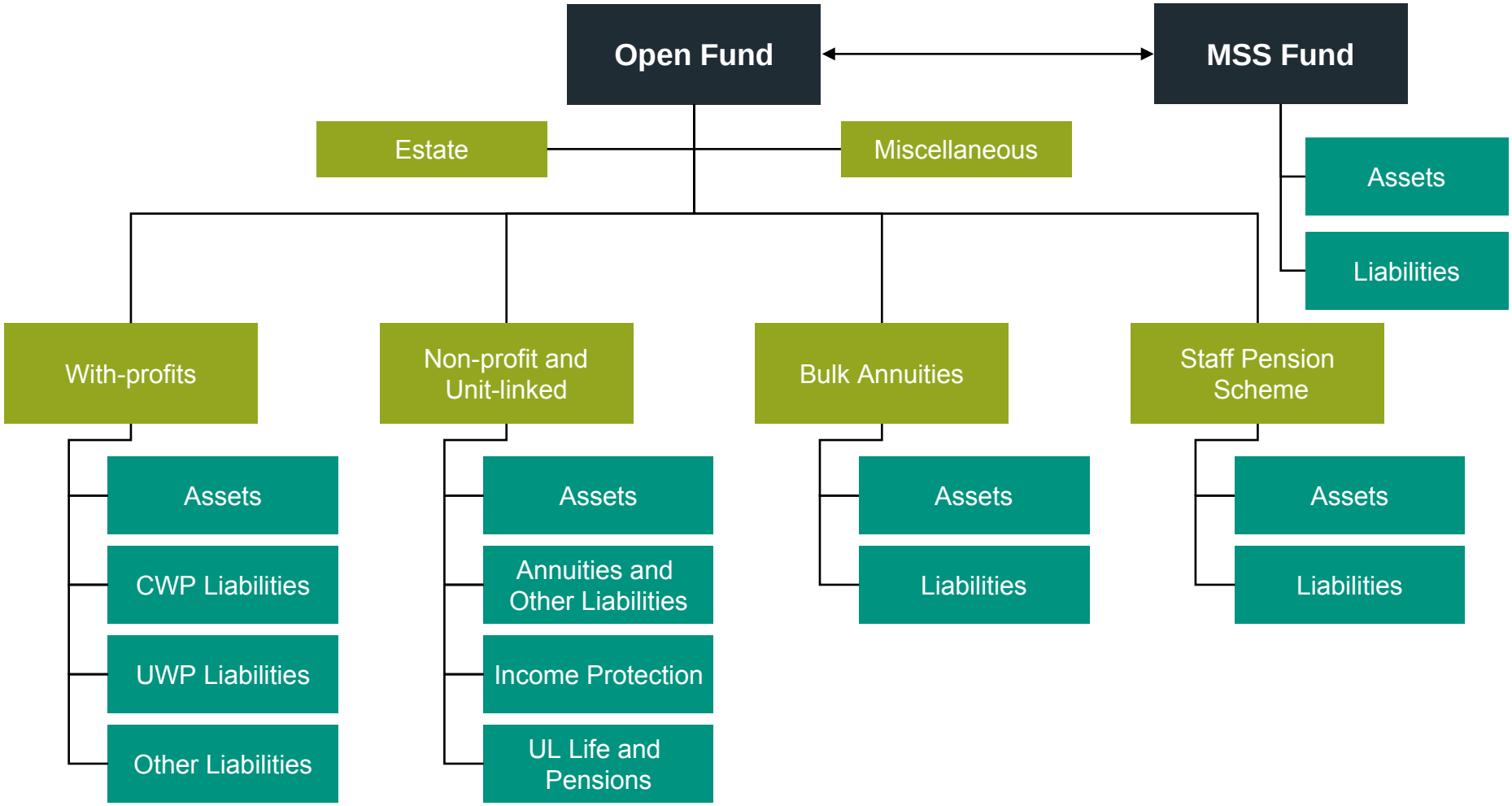
Developing an Internal Model for a Medium-Sized Company

Agenda

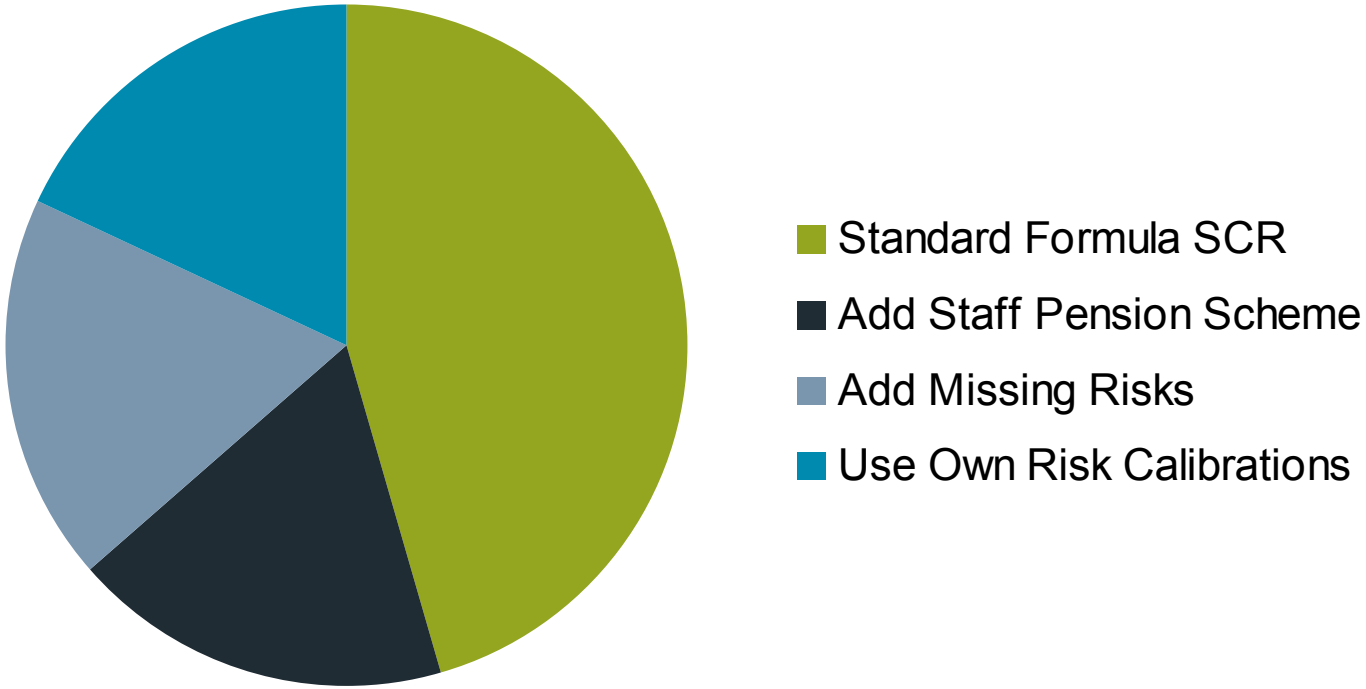
- Objectives of the Internal Model
- The Internal Model solution
- How the Internal Model is changing BAU
- Final thoughts
- Q&A

Objectives of the Internal Model

Objective: Capture business profile



Objective: Improve risk measurement



Standard Formula does not capture our risk profile

Objective: Improve risk measurement

1. Stress Tests → **2. Aggregate** → **3. Report Required Capital**

- Equity level
- Credit risk
- Equity volatility
- ⋮
- Operational risk

	Equity level	Credit risk	Equity vol	…
Equity level	100%	50%	75%	25%
Credit risk		100%	50%	0%
Equity vol			100%	0%
…				100%

→ ICA

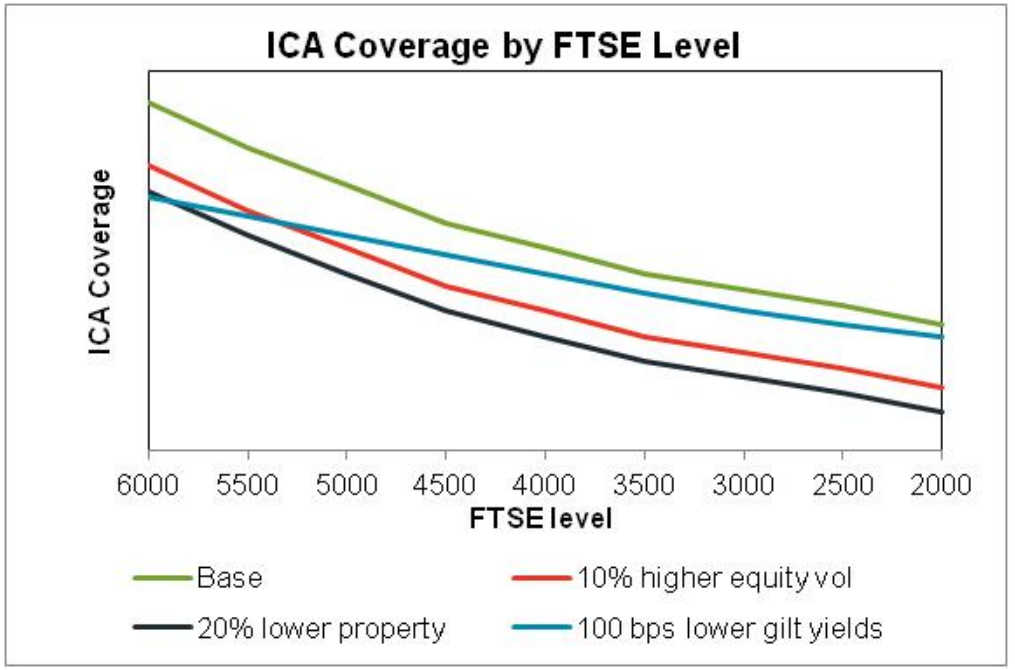
Only examine single point on distribution

Assumes losses are linear
Assumes risks are normal

Only provides one outcome
Difficult to allocate capital

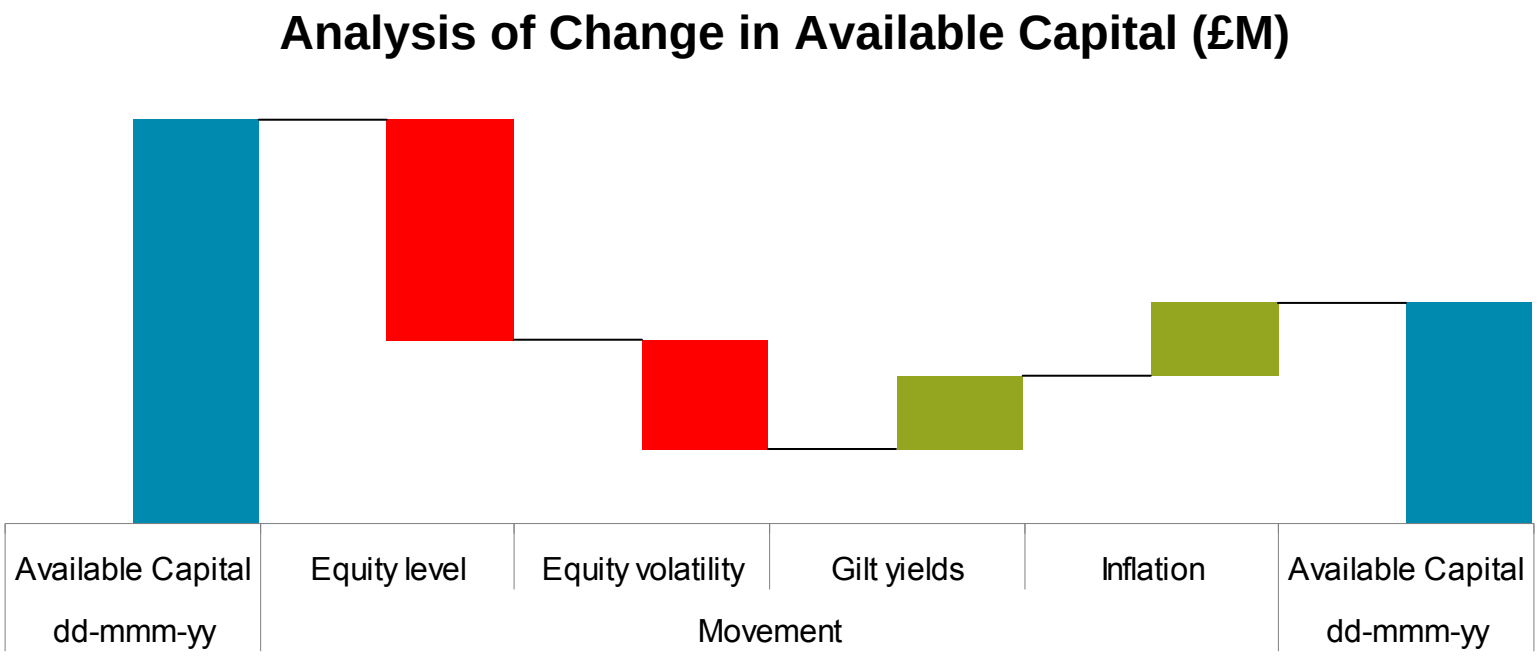
Objective: Improve risk monitoring

£m	dd-mmm-yy
Open Fund Assets	A
Open Fund Liabilities	B
Available Capital (C)	A - B
ICA	**D**
Surplus Capital	C - D
ICA Coverage	D/C
ICA FTSE Breach Point	XXXX



Current model captures key market sensitivities, but does not indicate a likelihood

Objective: Improve profit and loss attribution



Current model does not report at a sufficiently granular level and does not cover all risks

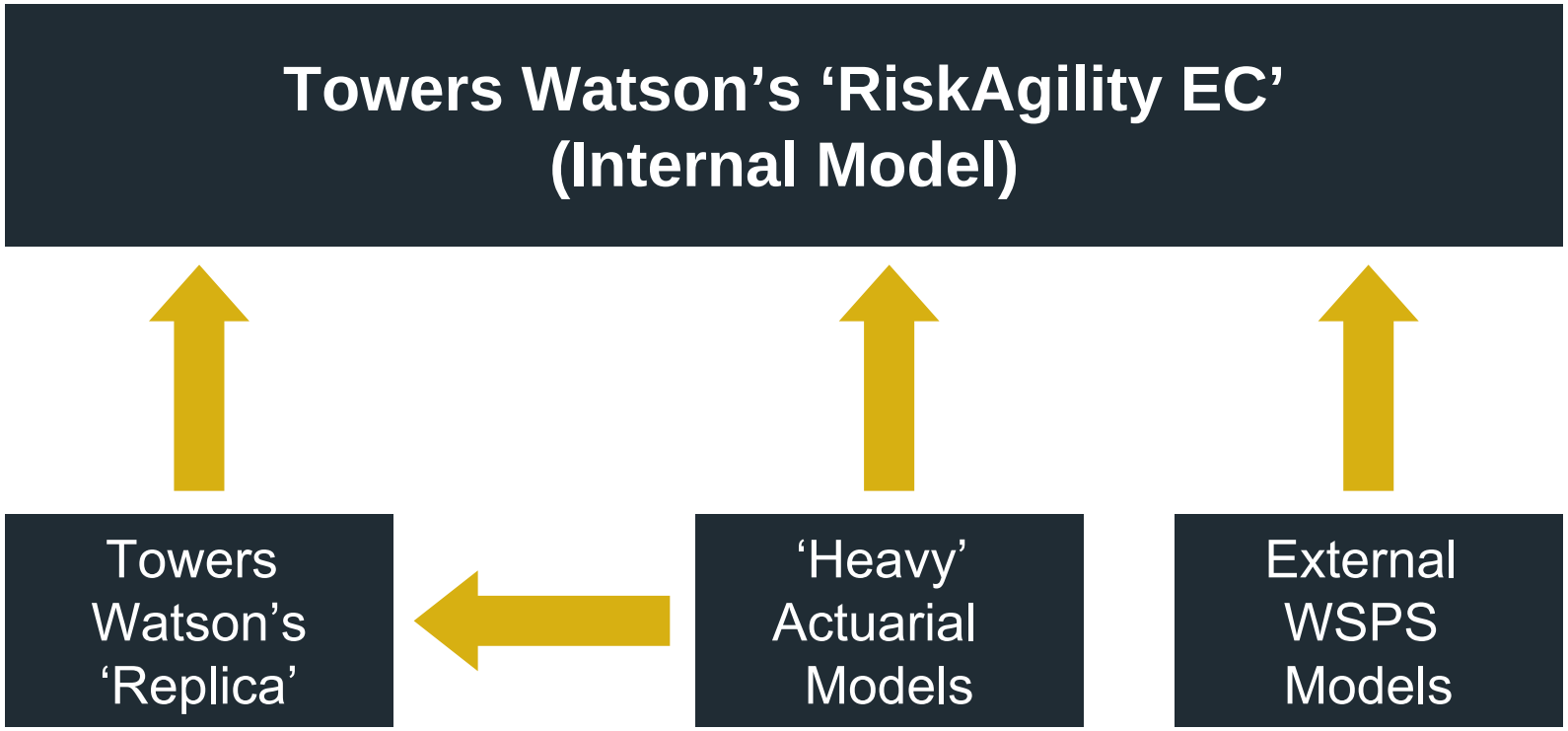
Summary of current model limitations

Objective	Limitations of Current Model
Risk Measurement	• Only provides a single outcome (0.5th percentile) • Assumes individual risks are normally distributed • Ignores non-linearity and non-separability of losses • Does not allocate required capital
Risk Monitoring	• Does not capture probability of “what-if?” events • Only captures key market risks
Profit and Loss Attribution	• Does not cover all risks • Does not attribute by source (i.e., line of business)

Current model cannot meet our objectives

The Internal Model Solution

The Internal Model builds on existing models



The Internal Model is calibrated to outputs from our existing models, which are already well developed and understood

The SCR is modelled using full simulation of a 1-year VaR approach to economic capital

1. Risk factors

Calibrate risk factors

- Definitions
- Distribution types
- Parameters

2. Risk factor dependencies

Specify dependency structure

- Copula type
- Correlation assumptions
- Other parameters

3. Loss functions

Calibrate loss functions

- Identify functional forms
- Fit coefficients
- Empirical loss functions

4. Additional features

Specify adjustments

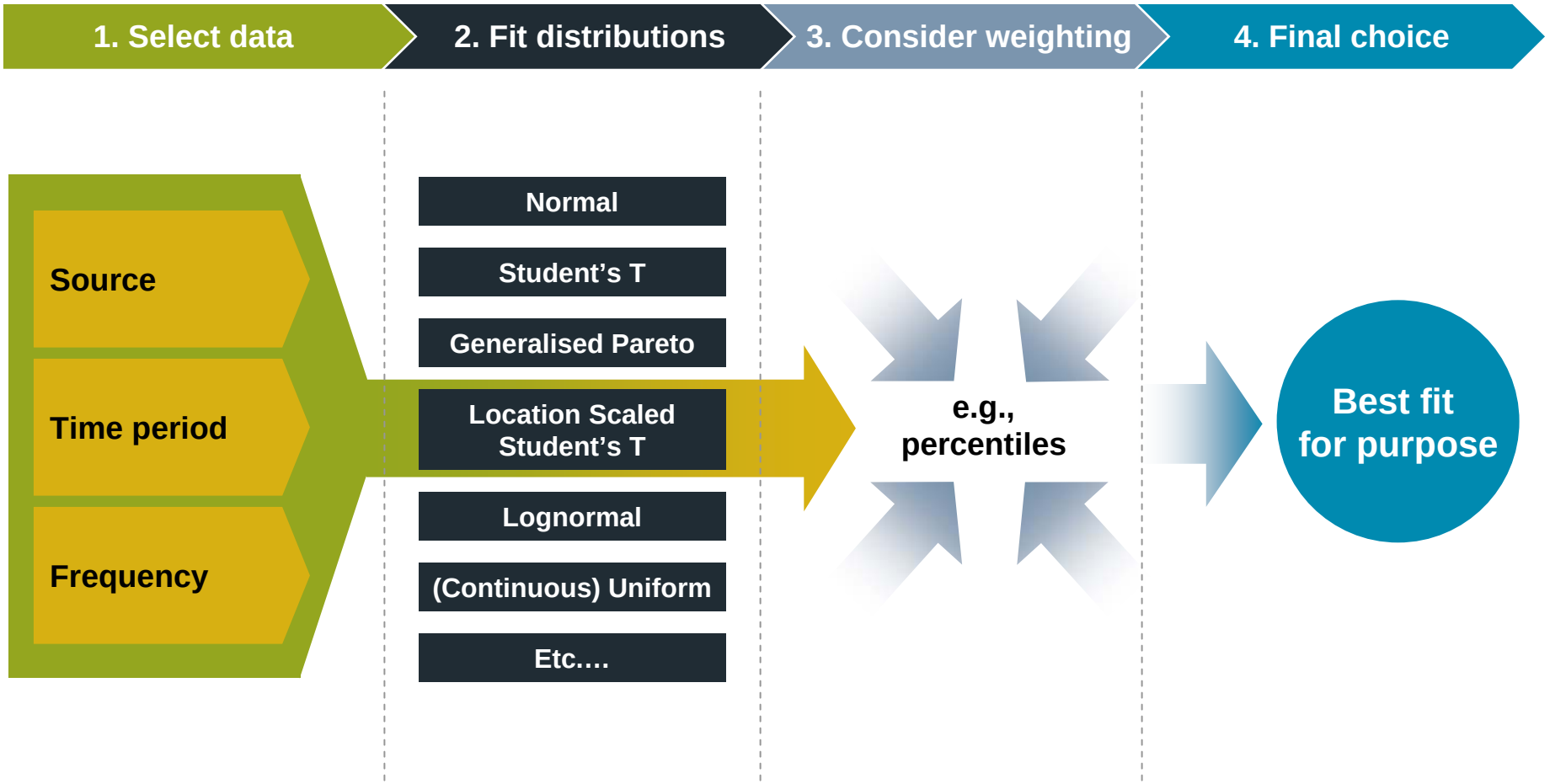
- Fungibility constraints / Add-ons
- Tax / Reinsurance

5. Monte-Carlo simulation

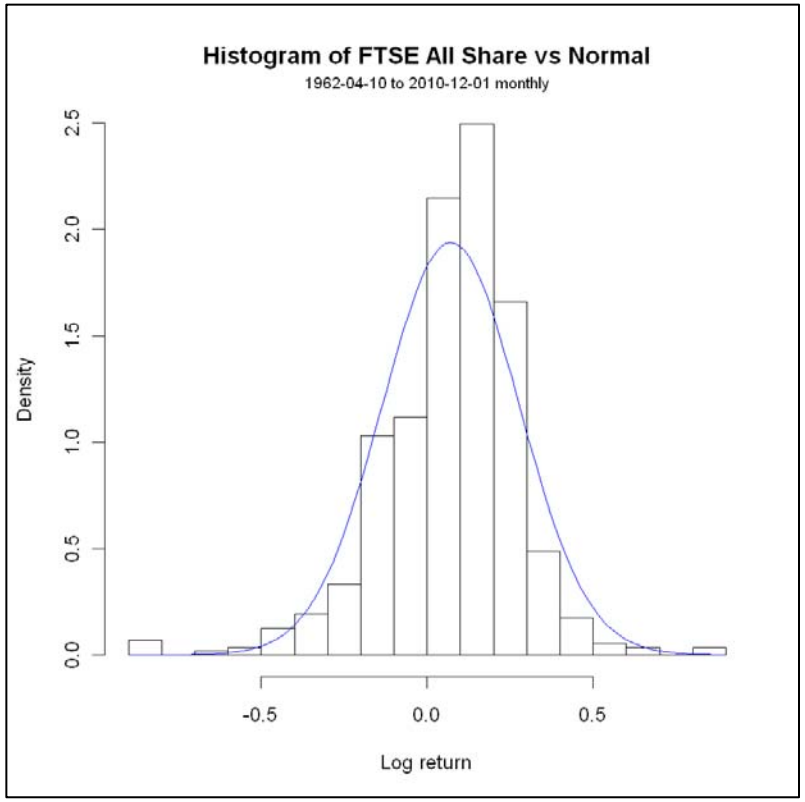
Calculate EC distribution

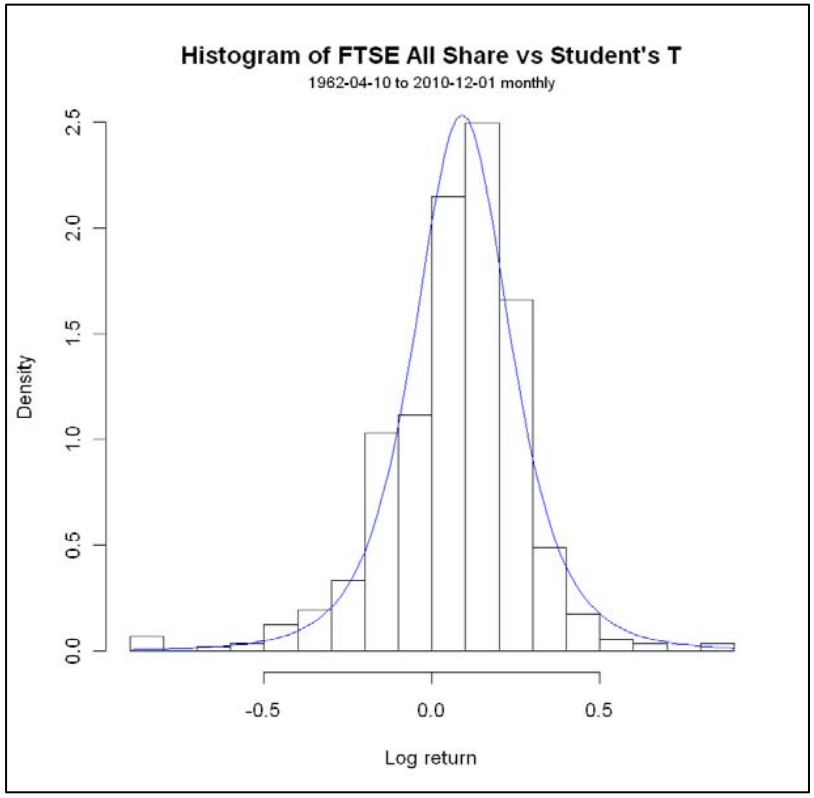
- No. of simulations / Algorithm / Seed
- Standalone / Diversified / Allocated
- With / without fungibility, tax and reinsurance

1. Risk factor calibration — The calibration process



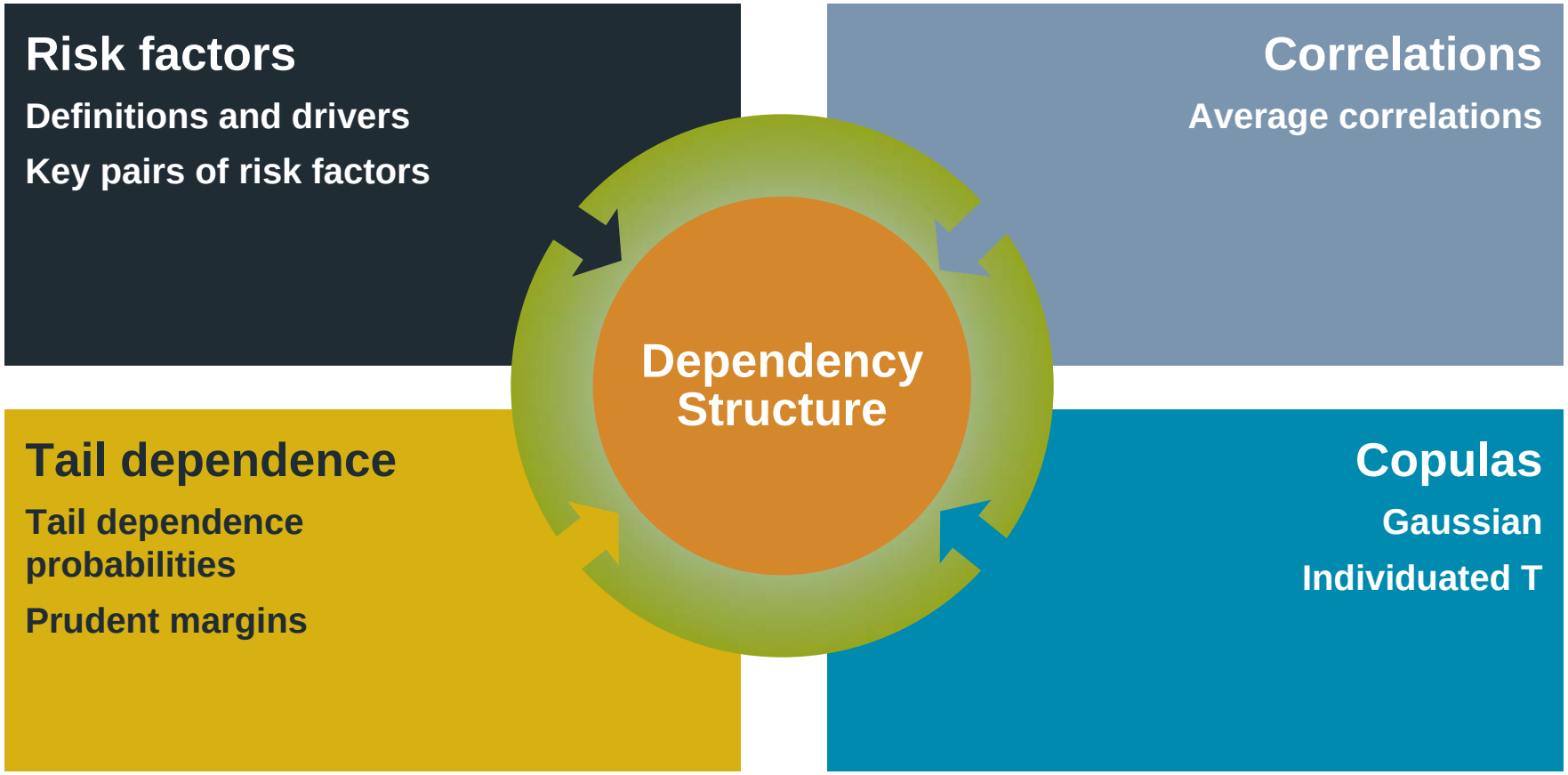
1. Risk factor calibration — Equity risk example





Student's T fits observed distribution of equity returns better than the normal distribution. Fit can be further improved in the lower tail via weighting techniques, but at the expense of a poorer fit in the upper tail

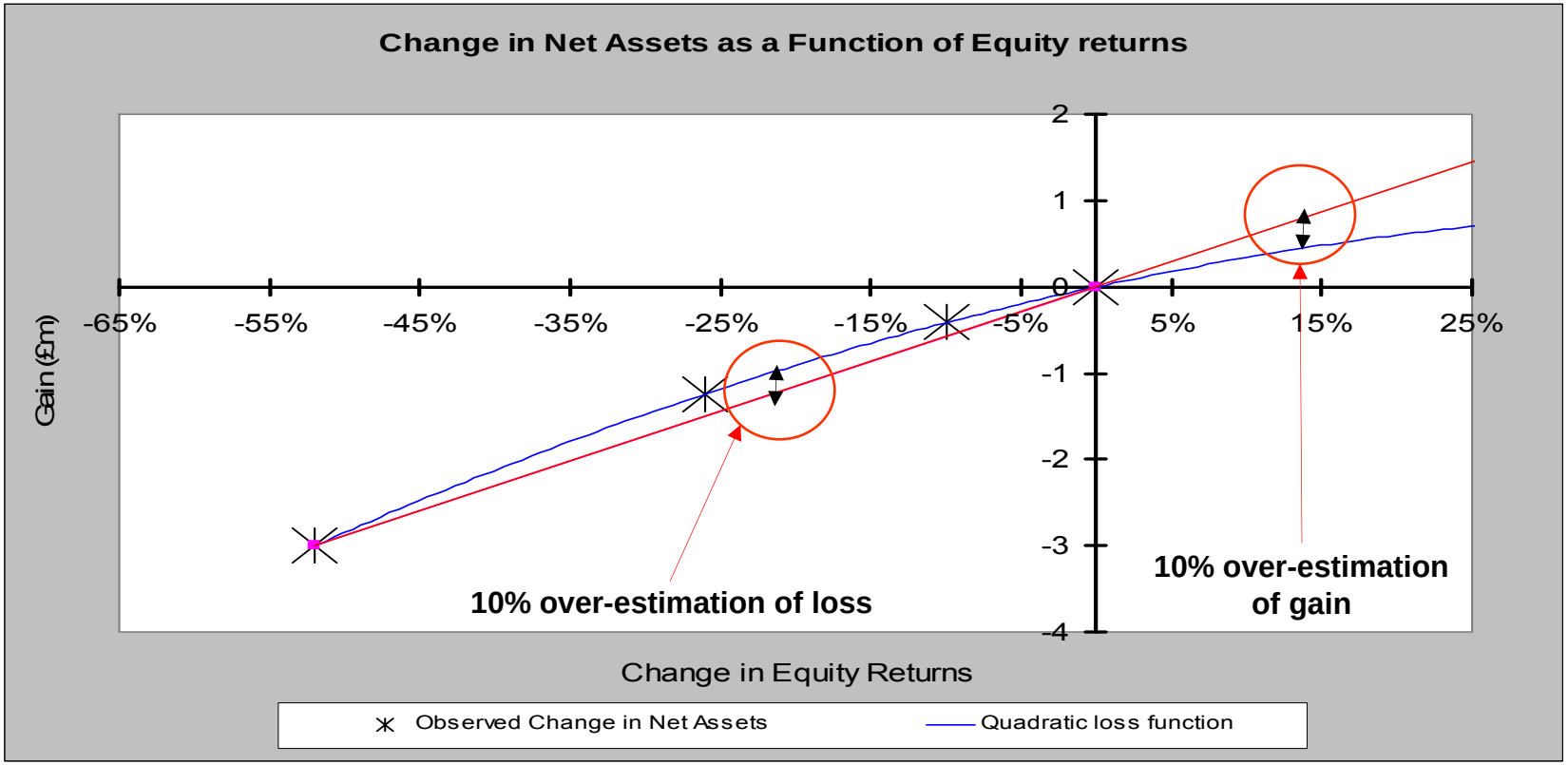
2. Calibration of risk factor dependencies



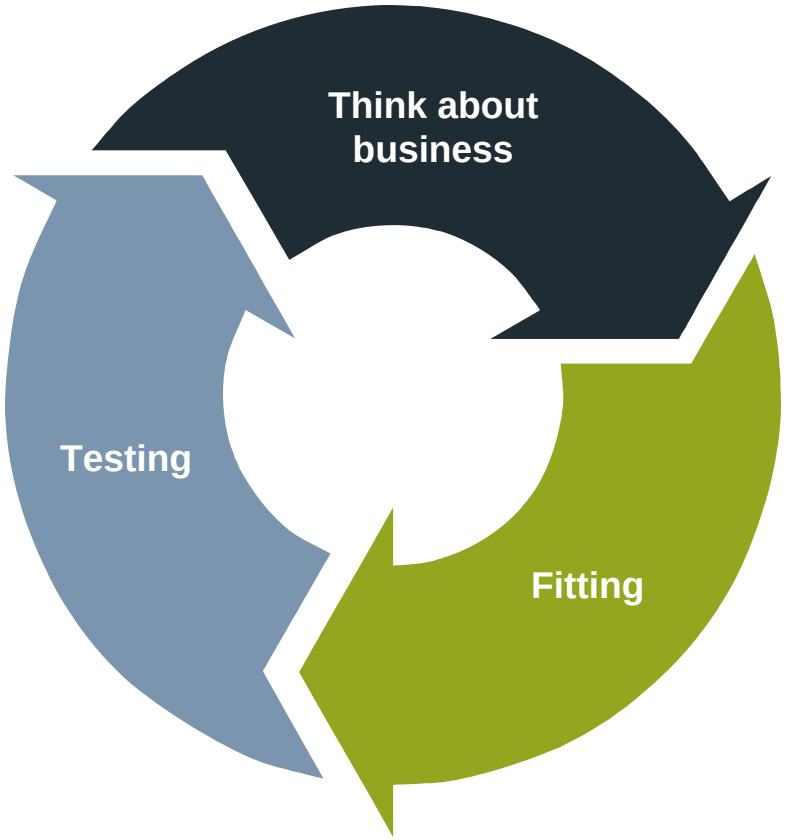
Judgement required may be significant; expert input and challenge are essential

3. Loss function calibration — Moving to a non-linear model

- A loss function:
  - Takes **risk factor values** as **inputs**
  - Produces **losses (or gains)** as **outputs**



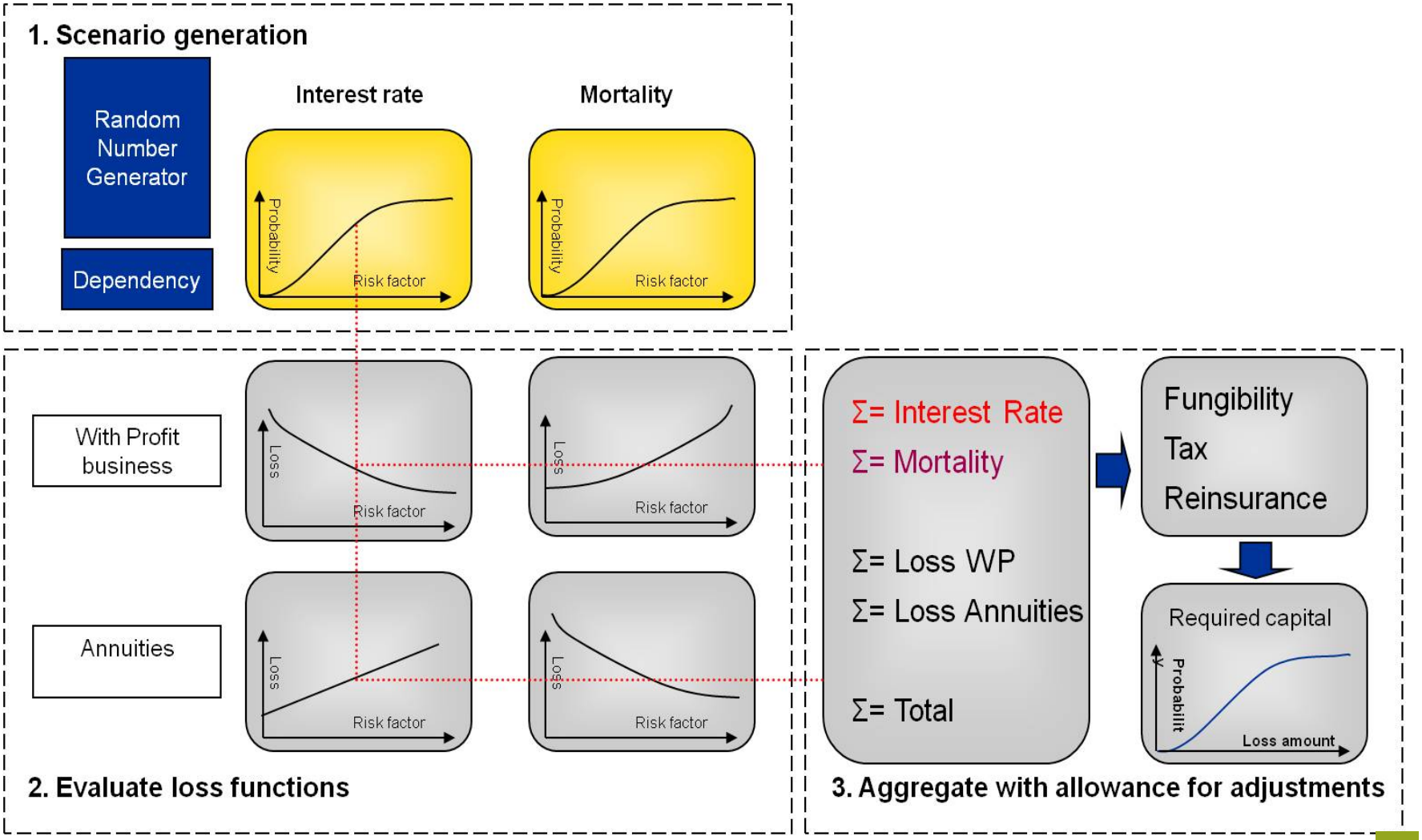
3. Loss function calibration — The calibration process



An iterative approach was adopted to develop and refine loss function calibrations…

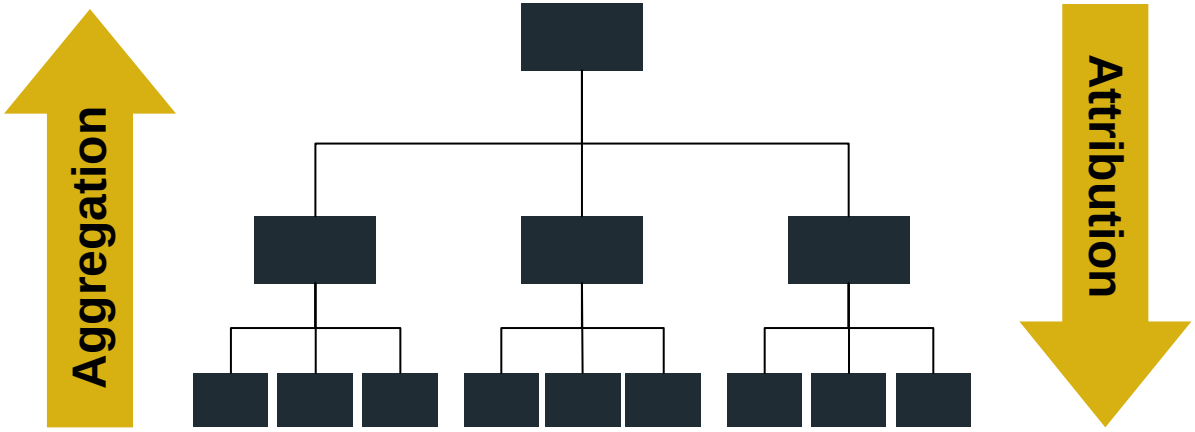
…this allowed us to target a required range of fit, to within desired materiality limits, as the Internal Model continued to develop

5. Monte-Carlo simulation within RiskAgility EC



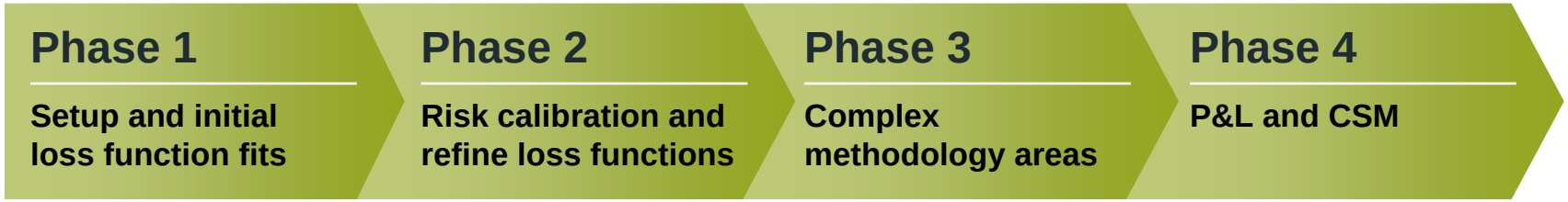
5. Aggregation and attribution of risk capital

- Aggregated risk capital available at all levels of company structure
- Overall diversification benefits can be allocated to individual risks and lines of business



Wesleyan can now attribute risk capital to individual risks and lines of business

We adopted a phased approach to implementation



Reconciliation to ICA within three months	Risk factor distributions, dependencies and non-linear loss functions	Management actions, fungibility and capital support	Monitoring Own Funds and SCR on a regular basis

Internal Model up and running within three months with a reconciliation to Wesleyan's ICA

Lessons Learnt

Project phasing worked well

PDF assumptions should have been tested earlier

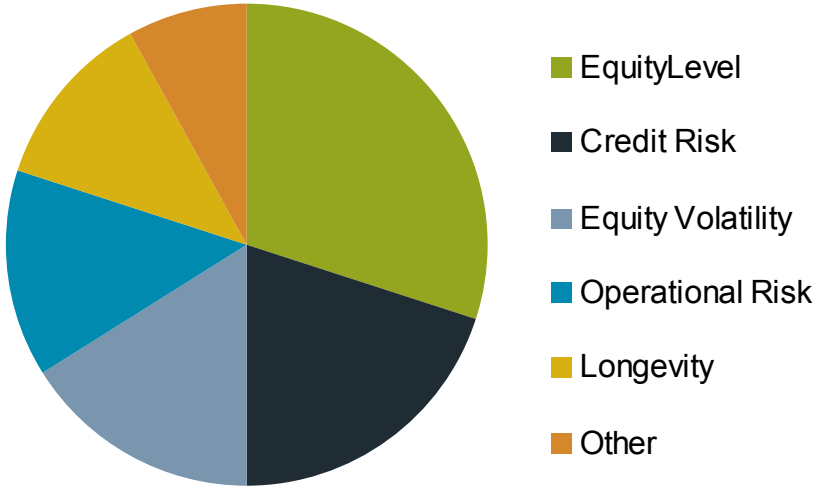
Loss function fitting took longer than expected

Automation and controls are more important than ever

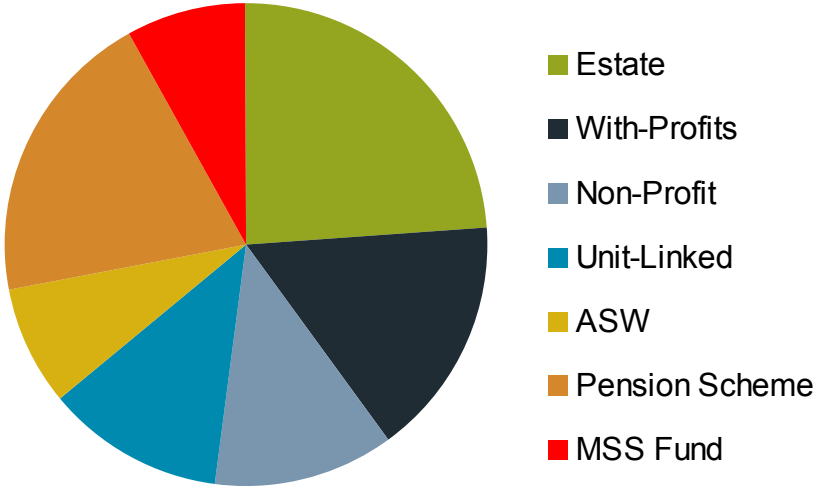
How the Internal Model is changing BAU

Improved risk measurement

SCR by Risk

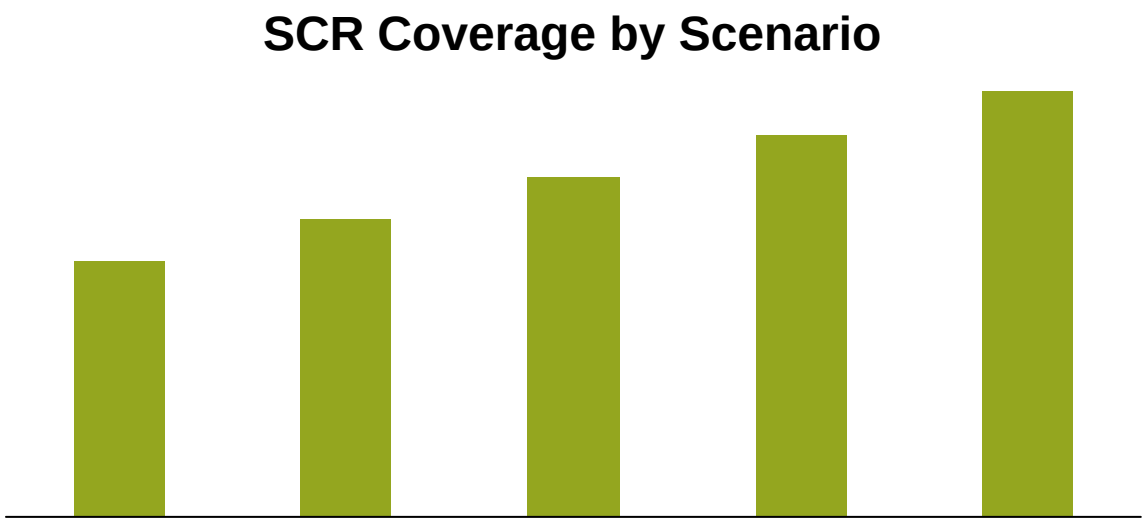


SCR by Business Unit



SCR methodology has been refined, and the result can now be robustly allocated by risk and by business unit

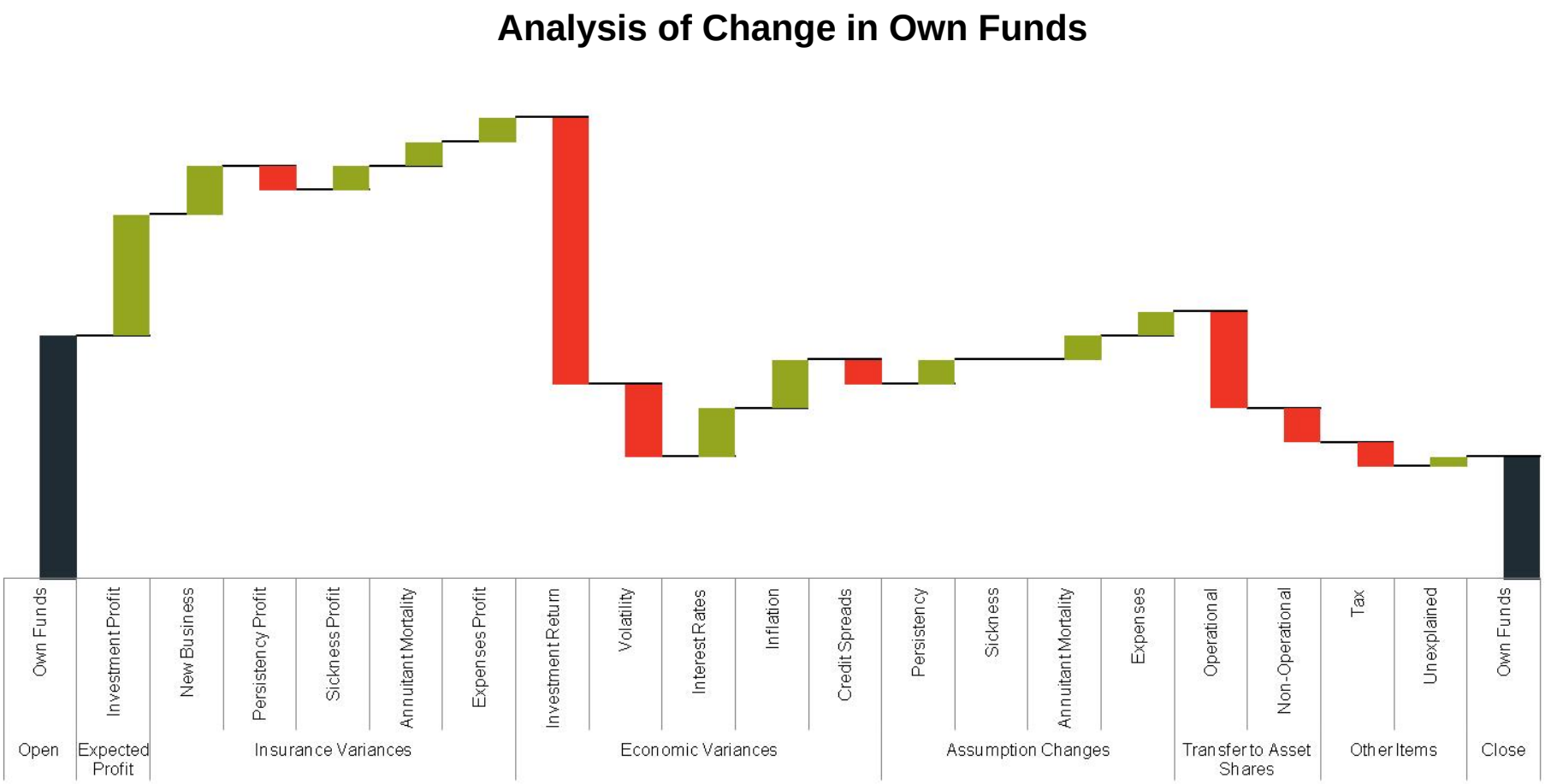
Improved risk monitoring



Probability	1 in 200	1 in 100	1 in 50	1 in 25	Current
Equity Volatility	35.0%	32.5%	30.0%	27.5%	25.0%
FTSE Level	3000	3500	4000	4500	5000

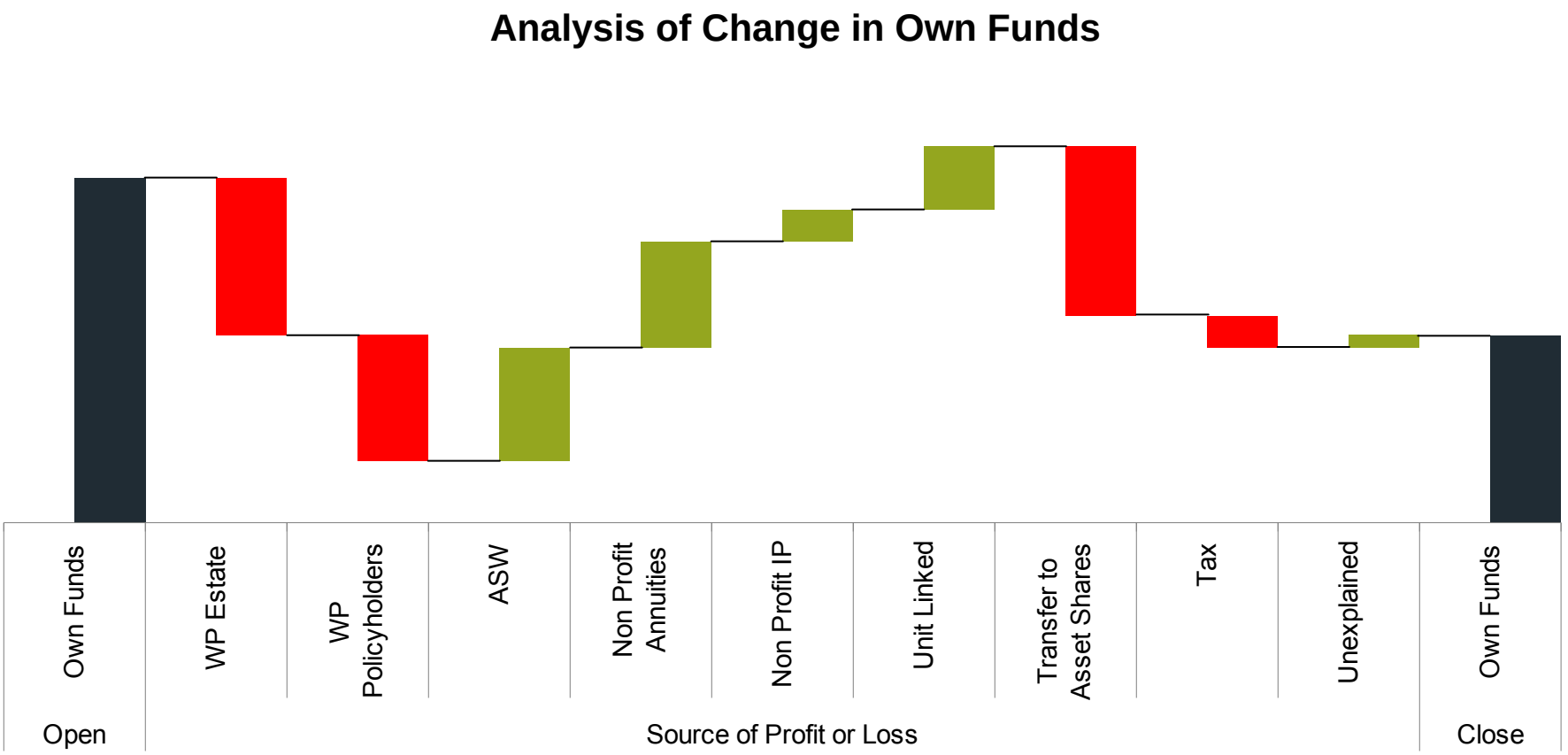
Wider range of "What-if?" scenarios can be considered, and a probability can be attached to these scenarios

Improved P&L attribution



Profits and losses now attributed by causes…

Improved P&L attribution



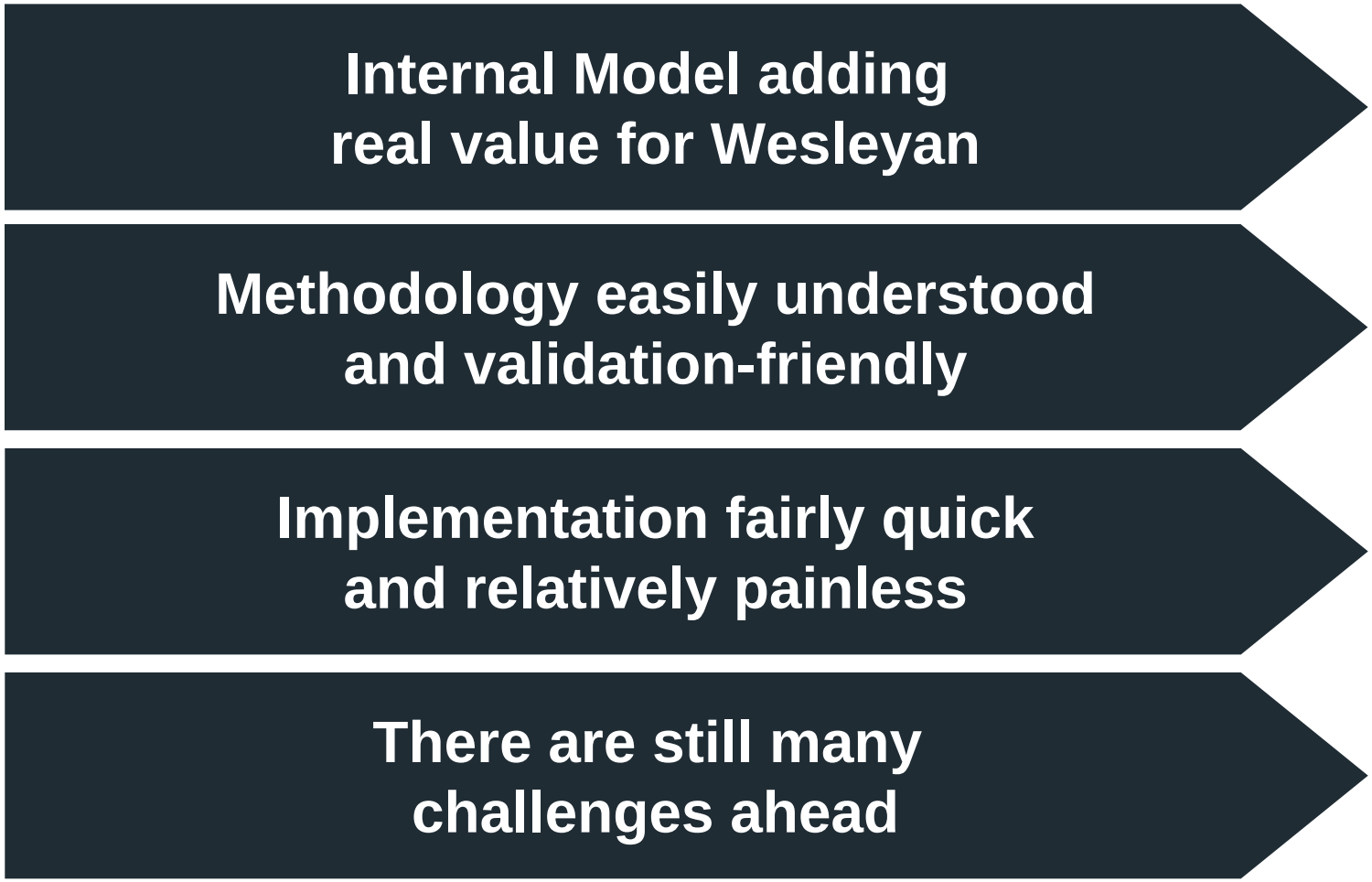
…and by sources (lines of business)

Does the Internal Model address the limitations of our current model?

Risk Measurement	✓	Provides a full probability distribution forecast
	✓	Captures non-normal risk distributions
	✓	Captures non-linearity and non-separability
	✓	Robust allocation of required capital
Risk Monitoring	✓	Captures probability of “what-if” events
	✓	Captures all key risks
P&L Attribution	✓	Covers all significant profit drivers
	✓	Attributes by cause and by source

Final Thoughts

Final thoughts



Questions or comments?

Expressions of individual views by members of The Actuarial Profession and its staff are encouraged

The views expressed in this presentation are those of the presenter