Equity-Based Insurance Guarantees Conference

Nov. 6-7, 2017

Baltimore, MD

Regulatory Change and ALM Systems

Peter M. Phillips

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Regulatory Change and ALM Systems

A discussion of the technogical impact IFRS17 will have on life insurance companies

Peter M. Philips

Session 3A: November 6, 2017 3:30 – 5:00 pm

PathWise Solutions Group

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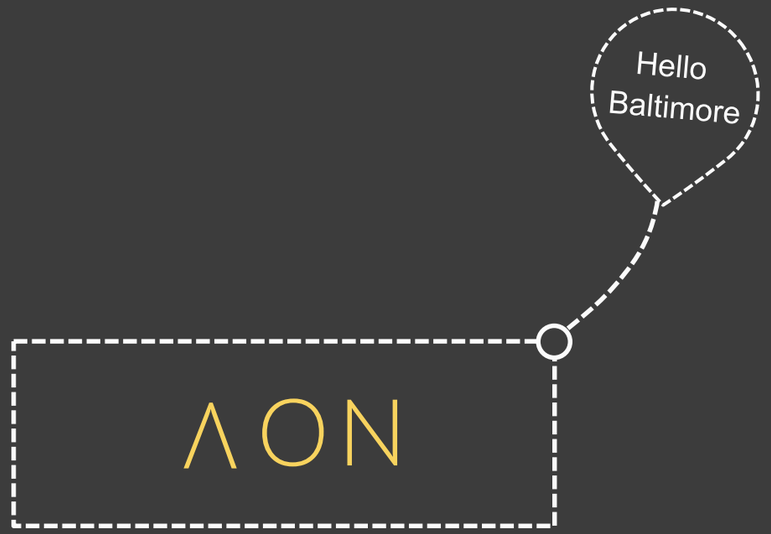

PRESENTED BY : PETER M. PHILLIPS

NOVEMBER 6th, 2017

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Equity-Based Insurance Guarantees Conference

Regulatory Change and ALM Systems

01 WHO
we are

?

Aon plc

Aon is founded in 1919 in Chicago, Illinois, USA. Headquarter in London, United Kingdom. We are ranked as the largest insurance broker in the world based on revenue. We have more than 500 offices in over 120 countries with more than 65,000 employees worldwide.

01

Aon Benfield

Focused on helping clients manage complex commercial issues by providing strategic advice.

Empower Results®

PathWise Solutions Group Offices

- Toronto
- New York
- Amsterdam
- Seoul
- Tokyo
- Other Aon Benfield Offices

Offices Globally

500 +

Country Coverage

120 +

Employees

65,000 +

Market Cap

$30 billion

Assets under Management

$100 billion

A leading capital and strategic advisor with global coverage bringing together 100 years of specialist experience

02 Market Overview

- ✓ IFRS17
- ✓ CSM example
- ✓ Impact of GDPR

Catalyst For Technological Change: New Regulations

IFRS17 is a new accounting standard which has large knock-on effects for companies in terms of data flows, compute burdens, and the need for flexible and intelligent automation, and improved end-to-end controls

European Life Insurers Market Overview

IFRS17

Managing New Complexity

- A New Accounting Standard
  - One accounting model for all insurance contracts in all IFRS jurisdictions, replacing IFRS 4
  - **126 our of 150** jurisdictions require IFRS standards
  - 450 listed insurers are effected
  - Extensive Consultation Process
    - Started in 1997, 900 meetings, 600 comment letters, and 4 rounds of field testing
  - **Mandatory effective date 2021**
  - 3.5 years for companies to implement the new requirements
  - Should address the **lack of comparability of financial reporting** for different jurisdictions
  - Hope is:
    - to provide more transparent and useful information to the marketplace
    - Consistent framework to replace a variety of accounting treatments

- Laundry List of Issues to Sort Through
  - Gap Analysis
  - Getting Audit Approval
  - Managing and explaining profit and loss volatility
  - Onerous contracts
  - Treatment of acquisition costs
  - Reinsurance
  - Granularity
  - BBA
  - Working alongside Solvency II
  - Impact on balance sheet
  - Governance
  - CSM
  - Discount rate mechanics
  - Presentation and disclosures
  - Transitional measure for existing insurance contracts—full retrospective, modified retrospective and fair value approach

European Life Insurers Market Overview

CSM worked example

Assumptions

- 1 contract
- 900 single premium
- 3 years of coverage
- 5% discount rate
- No lapse, mortality, PUP

- Claims at year ends 1, 2, 3:
  - Expected 200, 200, 200

Just after Initial Recognition: CSM

Balance sheet		
PV future cash flows (PVFC)	544.65	PV(5%,3,200)
Risk Adjustment (RA)	120.00	Assumption
Fulfilment Cash Flow (FCF)	664.65	PVFC + RA
Insurance contract liability	900.00	Premium received
CSM	235.35	Premium - FCF
P&L		
Insurance service expenses	-900.00	

European Life Insurers Market Overview

CSM worked example

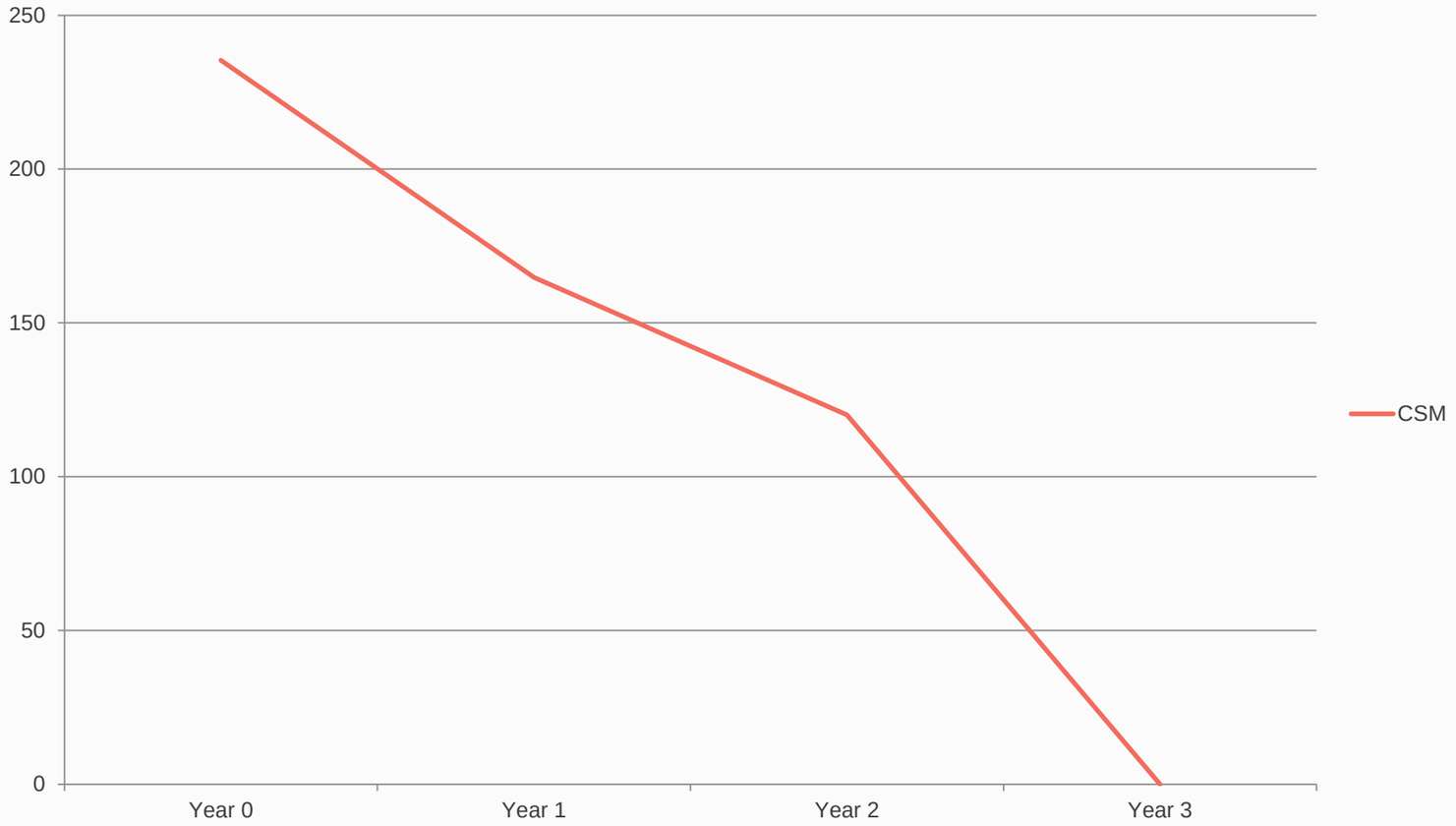
Assumptions

- 1 contract
- 900 single premium
- 3 years of coverage
- 5% discount rate
- No lapse, mortality, PUP

- Claims at year ends 1, 2, 3:
  - Expected 200, 200, 200
  - Realized 200, 150, 140

CSM run-off

CSM at initial recognition (profit making contract)	235.35



European Life Insurers Market Overview

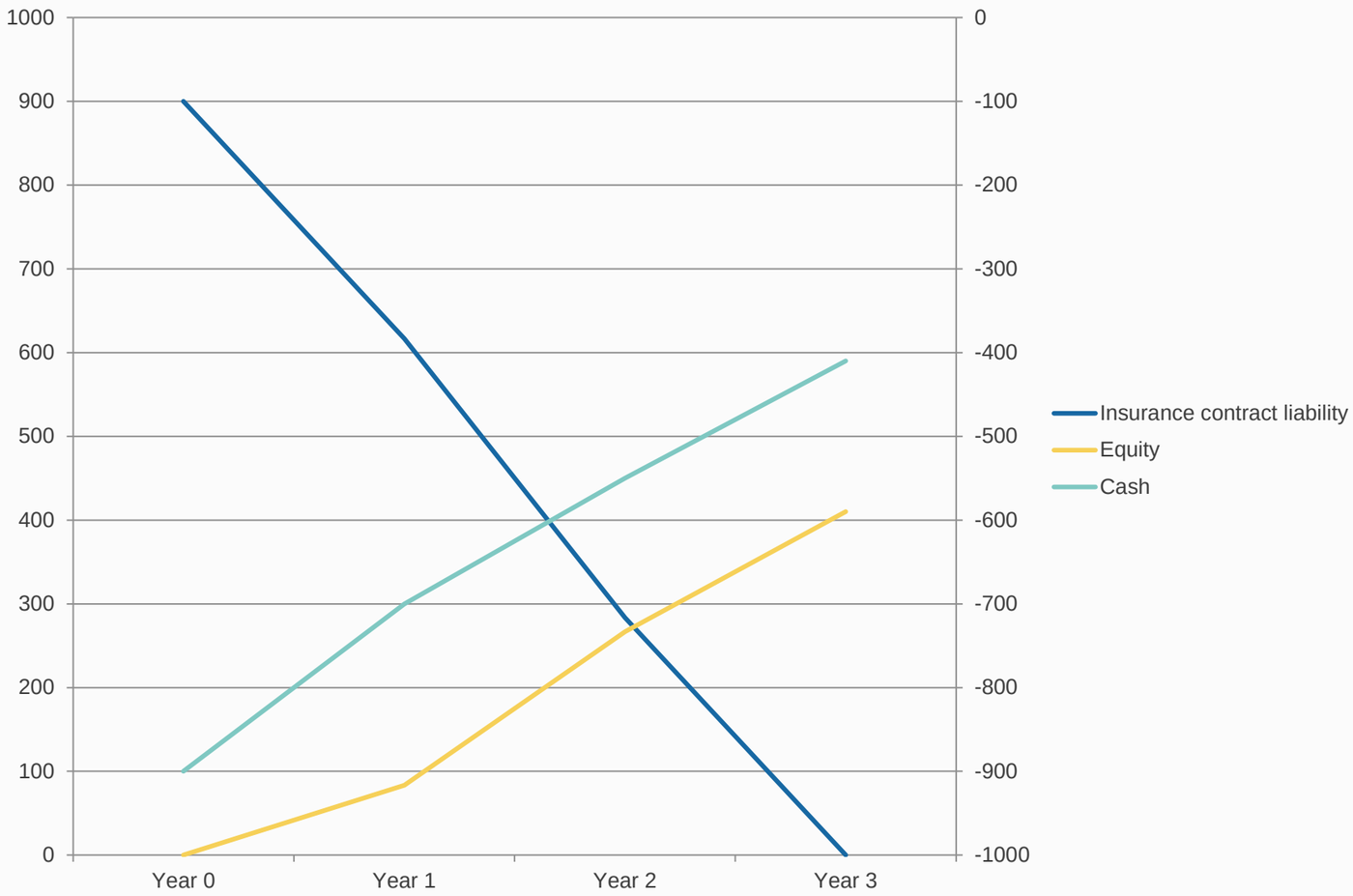
CSM worked example

Assumptions

- 1 contract
- 900 single premium
- 3 years of coverage
- 5% discount rate
- No lapse, mortality, PUP

- The cash position is displayed on the right axis and start with 900 premium income (-), and declines over time due to claim payments
- After receiving the premium, the insurance contract liability at t=0 is 900, which declines over time
- The resulting equity position is zero at t=0, but increases over time since it is a profit making contract

Statement of profit and loss



European Life Insurers Market Overview

Liabilities: EU General Data Protection Regulation

Impact of GDPR

"*The controller of personal data shall…implement appropriate technical and organizational measures...in an effective way...in order to meet the requirements of this Regulation and protect the rights of data subjects'.*"

The new European privacy law GDPR adds additional complexity to the handling of policy data, including third party usage.

Requirements require the deletion of personal data after the designated purpose has been fulfilled, and the policyholder should be able to receive an electronic version of the personal data any time.

- **GDPR also applies to organizations located outside of the EU if they offer goods or services to, or monitor the behavior of EU data subjects!**
- **Organizations can be maximally fined up to 4% of annual global turnover for breaching GDPR or €20 Million.**
- **Data breaches that can pose a risk to individuals must be notified to the DPA within 72 hours and the individuals without undue delay.**

European Life Insurers Market Overview

Liabilities: EU General Data Protection Regulation

Impact of GDPR

What constitutes personal data?

Any information related to a natural person or 'Data Subject', that can be used to directly or indirectly identify the person. It can be anything from a name, a photo, an email address, bank details, posts on social networking websites, medical information, or a computer IP address.

What is the difference between a data processor and a data controller?

A controller is the entity that determines the purposes, conditions and means of the processing of personal data, while the processor is an entity which processes personal data on behalf of the controller.

How does the GDPR affect policy surrounding data breaches?

Proposed regulations surrounding data breaches primarily relate to the notification policies of companies that have been breached. Data breaches which may pose a risk to individuals must be notified to the DPA within 72 hours and to affected individuals without undue delay.

GDPR will also be applied in the UK: https://ico.org.uk/for-organisations/data-protection-reform/overview-of-the-gdpr/

03 System Challenges

IFRS 17 System Challenges

New regulatory requirements are more complex and require the application of shocks on different scenarios under a stochastic framework.

As a result, the data, calculation, and reporting requirements will increase under IFRS17.

System Challenges Level of Aggregation

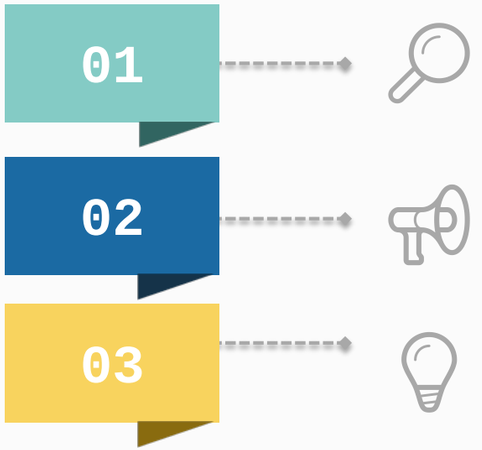
Scope IFRS 17: (re)insurance contracts and investment contracts with discretionary participation features.

For insurance contracts the level of aggregation needs to be **split by**:

Product lines for which the block of business is managed together

Contracts issued within a period of no longer than one year

Onerous, possibly onerous in the future, and remaining



Market Questions

What is the definition of a block of business managed together?

How do we deal with annual cohorts for contracts with mutualisation?

How to detect possibly onerous contracts in the future?

This could imply your system should be able to calculate the future cash flows, risk adjustments, and contractual service margins **for thousands of groups**!

Article 17: *"If the entity does not have reasonable and supportable information to conclude that a set of contracts will all be in the same group, it shall determine the group to which contracts belong by considering individual contracts."*

System Challenges Level of Aggregation

Scope IFRS 17: (re)insurance contracts and investment contracts with discretionary participation features.

Definition: A group/set of insurance contracts resulting from the division of a portfolio of insurance contracts need to be at least split in contracts within a period of no longer than one year AND at initial recognition: Are onerous, Have no significant possibility of becoming onerous subsequently, if any, or Do not fall into either a) or b), if any

Definition: A portfolio of insurance contracts are subject to similar risks and are managed together. Similar risks are within the same product line

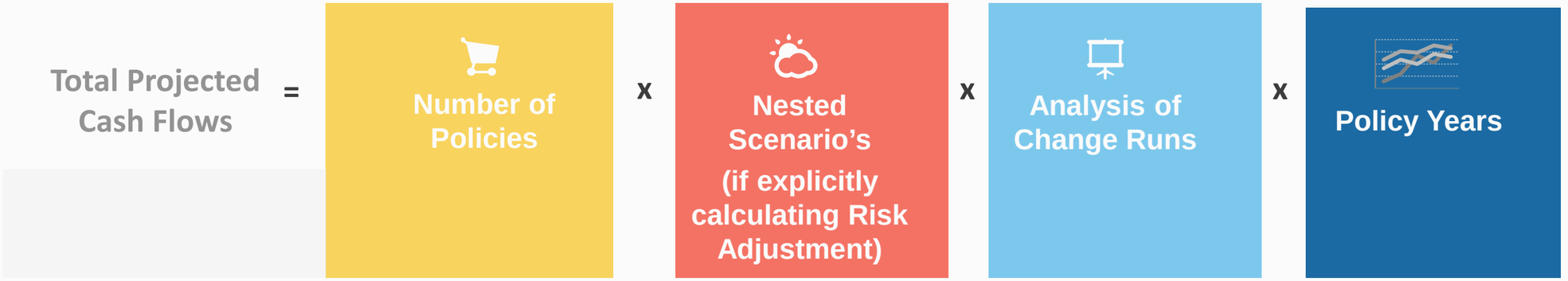
Compared to IFRS 4 and SII the new level of aggregation has 60 times more groups!! (new: for each period no longer than a year and onerous..)
Often single and regular premium are also considered different risk types. Or different distribution platforms (with different expenses or lapse behavior)
Our statement: Do it policy by policy (seriatim) to avoid expert judgment, documentation and have more precise results AND check your current system!

An entity with 10 product lines which have been underwritten for 20 years with quarterly pricing updates, the number of groups of insurances contracts will at least be: 10*20*4*3 = 2400

System Challenges Future Cash Flows

Future Cash Flows require real-world simulations because of uncertainty in future outcomes related to market and non-market variables

The amount of Cash Flows involved to determine the FCF with options and guarantees (intrinsic + time value is required) will be:



Article B36: "*The objective of estimating the future cash flows is to determine the probability-weighted mean of the full range of possible outcomes, considering all reasonable and supportable information available at the reporting date without undue costs or effort.*"

System Challenges Future Cash Flows

Total Projected Cash Flows	Number of Policies		Nested Scenario's		Analysis of Change Runs		Policy Years
138 Billion	200	x	1000*1000	x	23	x	30

For groups of insurance contracts : Fulfilment Cash Flow = Present Value of Future CFs + Risk Adjustment

Using multiple economic real-world scenarios aligns with "IFRS 9: Financial Instruments" which has to be implemented for European insurers at the same deadline as IFRS 17 being January 1, 2021. Given that you may want to do a parallel run and already disclose the possible impact in next year's reports you better start soon so you can get that audit sign off too!

The amount of calculations involved for a product with options and guarantees:

- 1000 real world outer loops for future
- 1000 risk neutral inner loops for the valuation of options and guarantees, but also the **Risk Adjustment**
- 20 shocks to conduct a movement analysis (e.g. new contracts, insurance finance expense, cash inflows, current services) but also key sensitivities) in order to show the impact on a) the fulfillment cash flow, the risk adjustment, the CSM, P&L, …

- Estimated probabilities for market and non-market variables may not contradict observable market prices (e.g. future inflation) – Market consistency

System Challenges The Risk Adjustment

For Groups of Insurance Contracts

Risks with a wider probability distributions should have higher risk adjustments than risks with a narrower distributions

Low frequency high severity products should have higher risk adjustment than high frequency low severity products

Contracts with a longer durations will have higher risk adjustments than contracts with a shorter durations

The Risk Adjustment should be based on scenarios in order to determine the cash flows at the corresponding confidence level

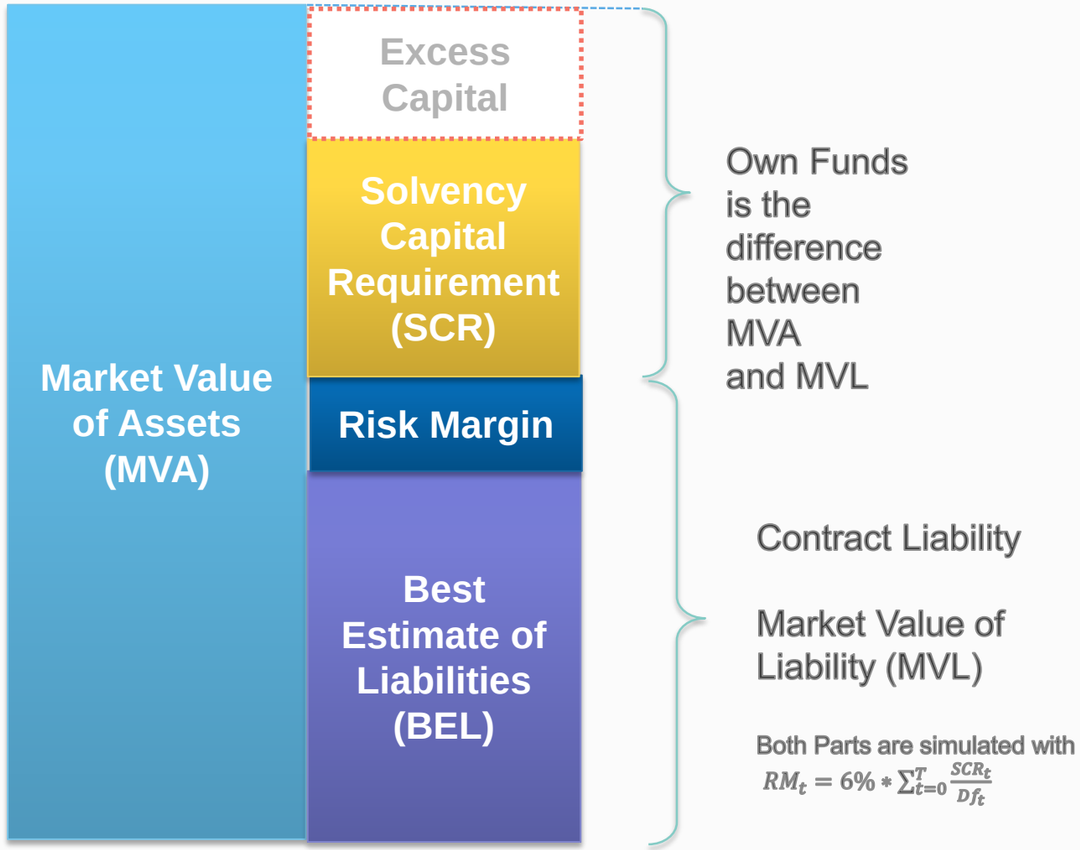
The Risk Adjustment needs to be tested on these criteria

Groups of insurance contracts also need to be grouped by duration

System Challenges The Risk Adjustment

For Groups of Insurance Contracts

Solvency II—Balance Sheet



Vs.

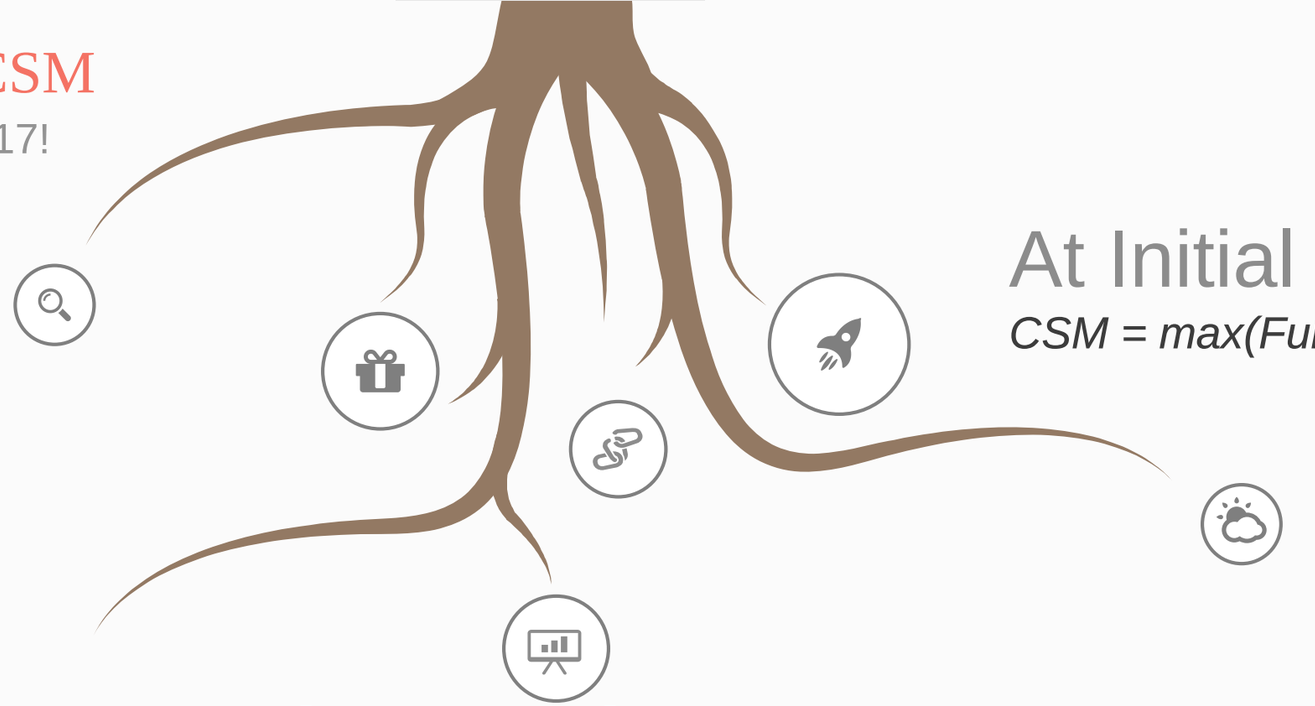
FRS17—Liability

Solvency II Ratio is equal to the ratio of Available Capital to the Solvency Capital Requirement (SCR)

When Own Funds falls below the Solvency Capital Requirement (SCR), the insurance company is considered insolvent

System Challenges The CSM

One run is not enough for IFRS 17!



At Initial Recognition:

CSM = max(Fulfillment Cash Flow, 0)

Afterwards the CSM changes by:

a) New Contracts

b) Insurance finance expenses: Effect of interest accretion on the carrying amount of the CSM

c) Changes in the fulfillment cash flows

   i. Experience adjustments arising from premium received and related cash flows
   ii. Changes in the estimates of the PVFCF
   iii. Changes in the risk adjustment
   iv. Differences between any expected and actual investment components

d) Insurance revenue (profit) recognized

Other System Challenges

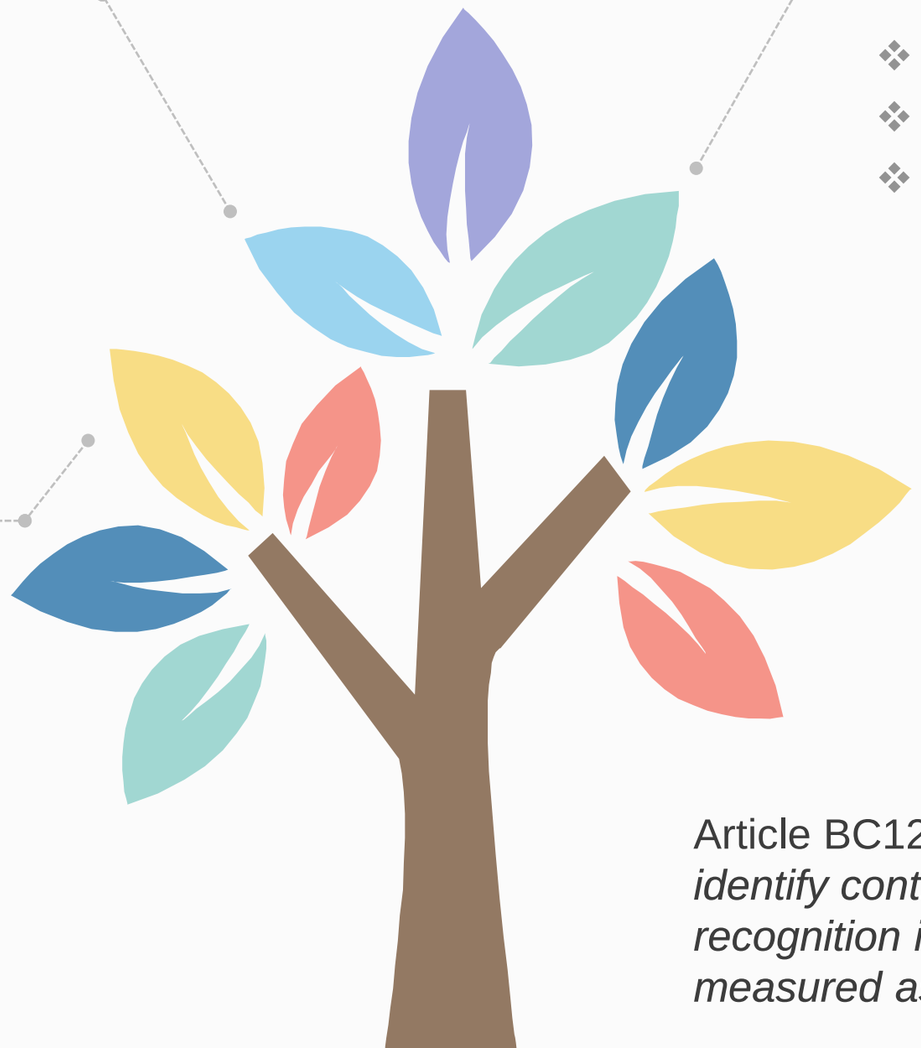
Financial results and the quality of explanation are different for each choice

Onerous Policies

- How to determine which polices are onerous?
- Which policies have a significant probability of becoming onerous?

Accounting

- How to account for policies if they have investment components?
- Which accounting choices do we have?



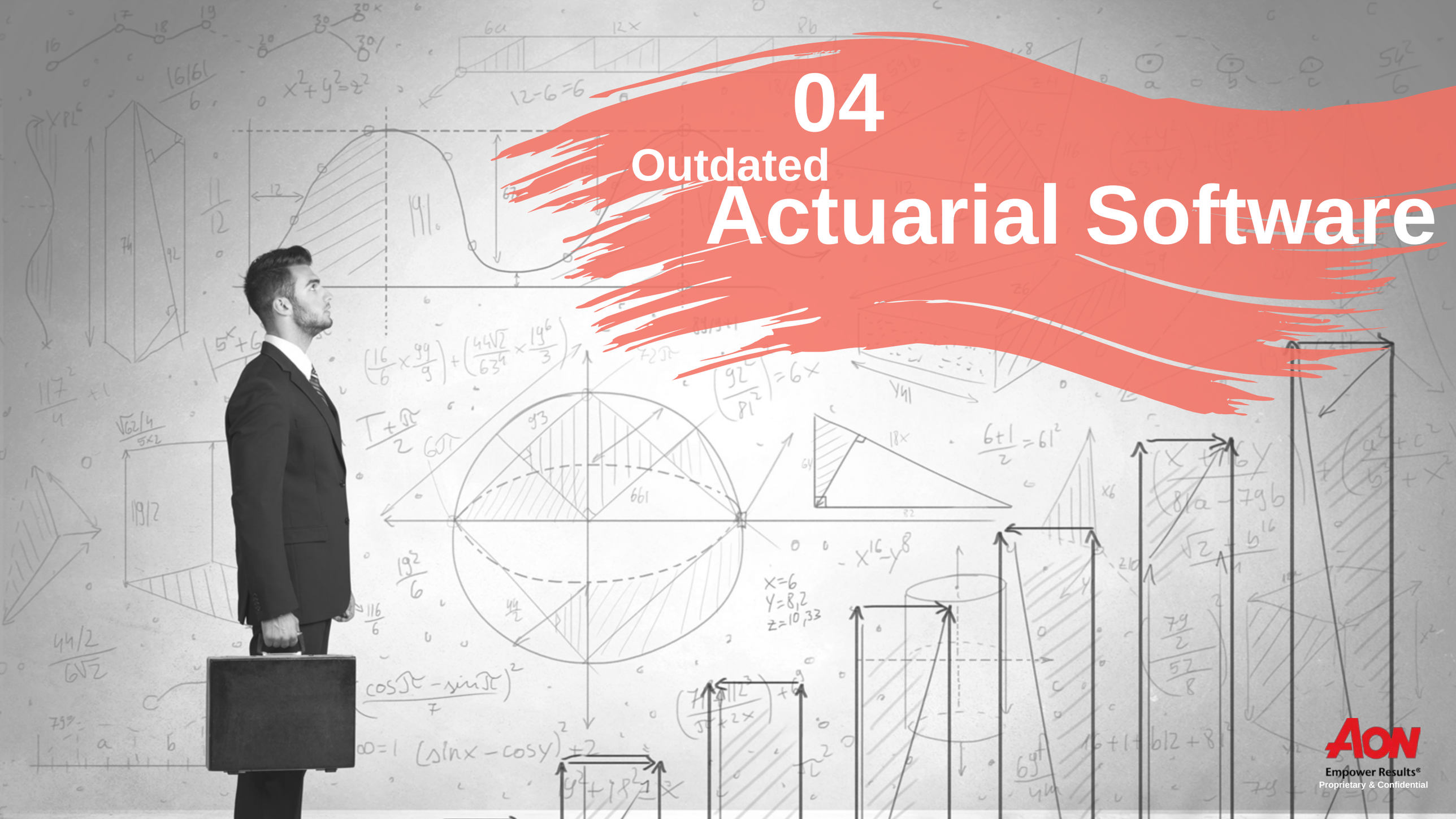
Common trade-offs

- Seriatim" Speed vs. granularity
- Aggregation: Proxy, Grouping, Clustering
- Cohorts: How to report by different cohorts after projections?

Article BC129: *The objective of the requirement to identify contracts that are onerous at initial recognition is to identify contracts that are onerous measured as individual contracts.*

04

Outdated Actuarial Software



Outdated Actuarial Software Low Productivity

Results in complicated governance

Low Productivity Outdated Actuarial Software:

- Separate inforce and assumption management, liability valuation, risk management, and scenarios generation systems do not communicate well with each other

- Error prone and slow manual manipulation of inforce, assumptions, scenarios, and file transfer to perform basic tasks

- Actuaries often use Excel spreadsheets to make outside model corrections, and to model new products, and use it as an auditing tool.
  Then the spreadsheets are loaded into a database by the IT department, which takes time and reduces flexibility for pricing, valuation, and/or capital planning.

Outdated Actuarial Software Low Performance

Its great to get a results from your systems but that is not a good enough starting point…

Low Performance for Outdated Actuarial Software:

- Legacy actuarial systems have low performance (Gflops / dollar) and they are not designed to scale efficiently over hundreds of thousands of cores

- Valuation actuaries working on regular financial reporting are hard pressed to meet regulator timelines. Often they do not have enough time to analyze the results properly or handle additional IFRS17 reports due to:
  - Solvency II
  - ORSA
  - Other internal or regulatory reports
  - Lack of actuarial resources or budget constraints

- Most companies have a Disaster Recovery site, but it takes hours/days in case of a disaster or software/hardware failure because of:
  - Lack of active data replication (weekly instead of daily)
  - Legacy systems do not have native support for high availability

Outdated Actuarial Software Black Box Solutions

Lack of Transparency for Outdated Actuarial Software

- There is no centralized system to keep track of all the data in financial reporting and risk management systems

- **Outdated actuarial software means black-box software as order of operations and every step of every calculation is not shown:**
  - Incompatible with IFRS17 requirements
  - Incompatible with level of aggregation and granularity
  - Difficult for internal and external auditors

- There is a governance issues to sort out for bugs, issues, changes, and enhancements to all the systems used in production

Outdated Actuarial Software Impossible ALM

Traditional actuarial models vs market-consistent models

Stochastic-on-stochastic simulation may be required for ALM and economic capital calculations due to path-dependent assets and liabilities and need to calculate risk adjustment and margin.

Outer loop

- Simulation of the risk factors on a real measure basis (real world)
- Calibration of the outer loop scenarios is based on historical data and expert judgment
- Correlation (especially tail correlation) critically important

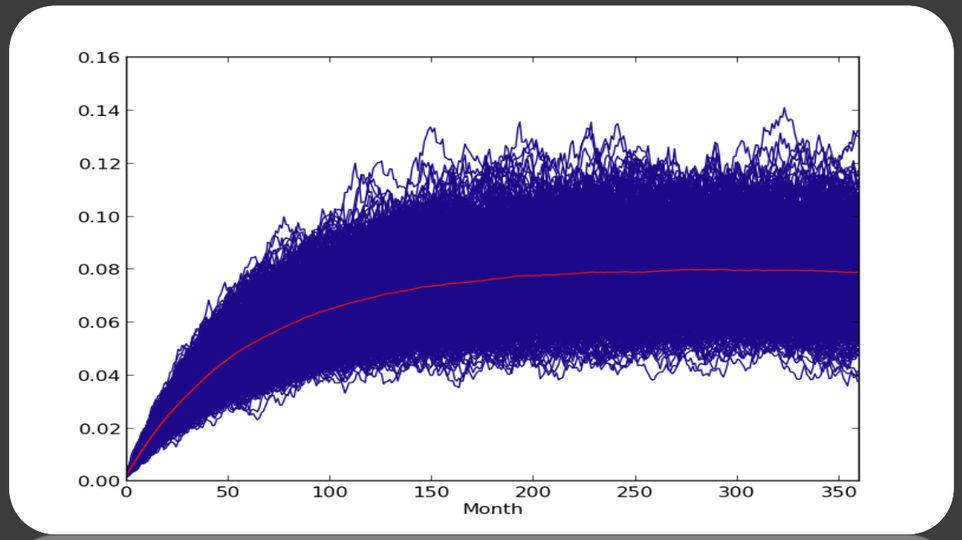
Inner loop

- Risk-neutral simulation based on state variables from the outer loop (covered in the previous section)
- Output includes BEL for liability and market-consistent valuations for assets

Outdated Actuarial Software Impossible ALM

IFRS17 imposes difficult missions for ALM systems

Real World Scenarios

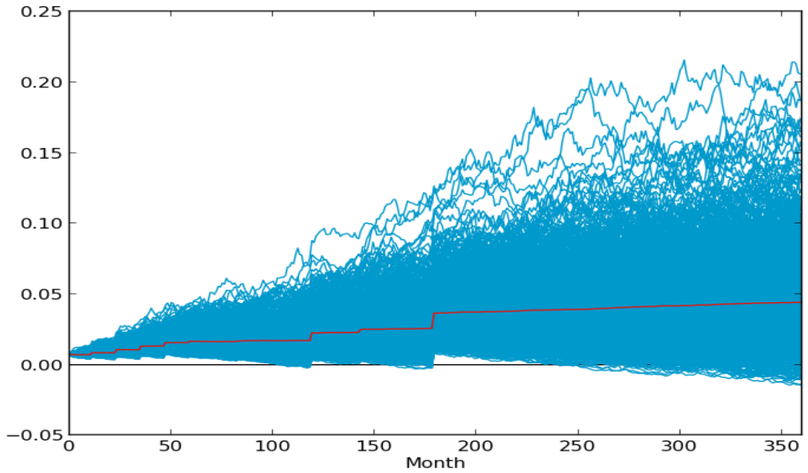


Stochastic real-world short rate paths

- Positive rates
- Higher average rates due to historical mean reversion assumption
- Does not reproduce market yield curve

VS

Risk Neutral Scenarios



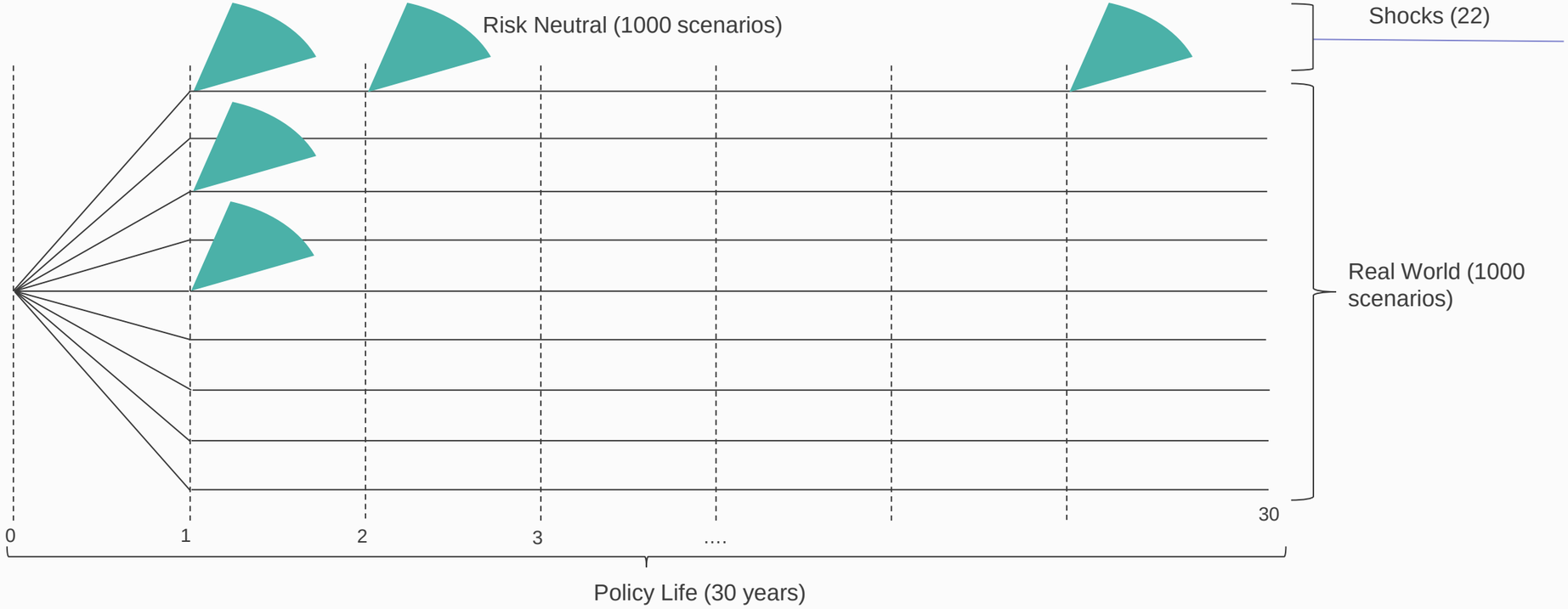
Stochastic risk-neutral short rate paths

- Possibility of negative rates
- Low rates more probable
- Reproduces market yield curve
- Tremendous impact switching from real world

Case Study Korean Implementation Issue

Pricing

- Normally, pricing procedure for traditional interest rate sensitivity product only uses a few “best-estimated assumptions” to calculate profit margin
- Because of Interest rates sensitivity and market volatility, Insurance companies need to consider product’s embedded values, such as MCVNB, when computing profit margin
- To calculate risk margin, nested simulation is necessary



1000 x 30 x (22+1) x 1000 **= 690 Million Calculation （Per Policy）**

Case Study Korean Implementation

Variable Universal Life Pricing Example

Total Projected Cash Flows	Number of Policies		Nested Scenario's		Analysis of Change Runs		Policy Years
138 Billion	200	x	1000*1000	x	23	x	30

Results

- Policy level Nested Simulation
- Policy level cash flows
- Policy level risk margin
- Risk Sensitivity

	1000x CPUs	60x GPUs
Total Projection	138 Billion	138 Billion
Speed (per sec per core)	400 Scenarios	160,000 Scenarios
Total Run Time	96 hours (4 days, estimate)	**4 hours**

05

Data Challenges

Data Challenges Legacy Data

Additional Requests for Legacies

New data requirements under IFRS 17

Losses are taken now

Losses go directly though the P&L while profits are smoothed over the coverage period. This requires different data treatment.

Underlying Items

Discount rate for Life cash flows with participation features **must** reflect the dependence on the underlying items.

Contact Boundaries

Contract boundaries need to be updated every reporting period (for each group).

Discounting

For Life and Non-Life a different discount curve is used for each group (or contract) at initial recognition and thereafter.

Non-Life

Non-Life cash flows **must** be discounted.

Market Rates

Comparison of market and non-market variables to the financial market information.

To calculate the CSM, many of the required data fields are missing from current databases, models, and reporting templates.

Data Challenges Data Cleansing

Additional Requests for Legacies

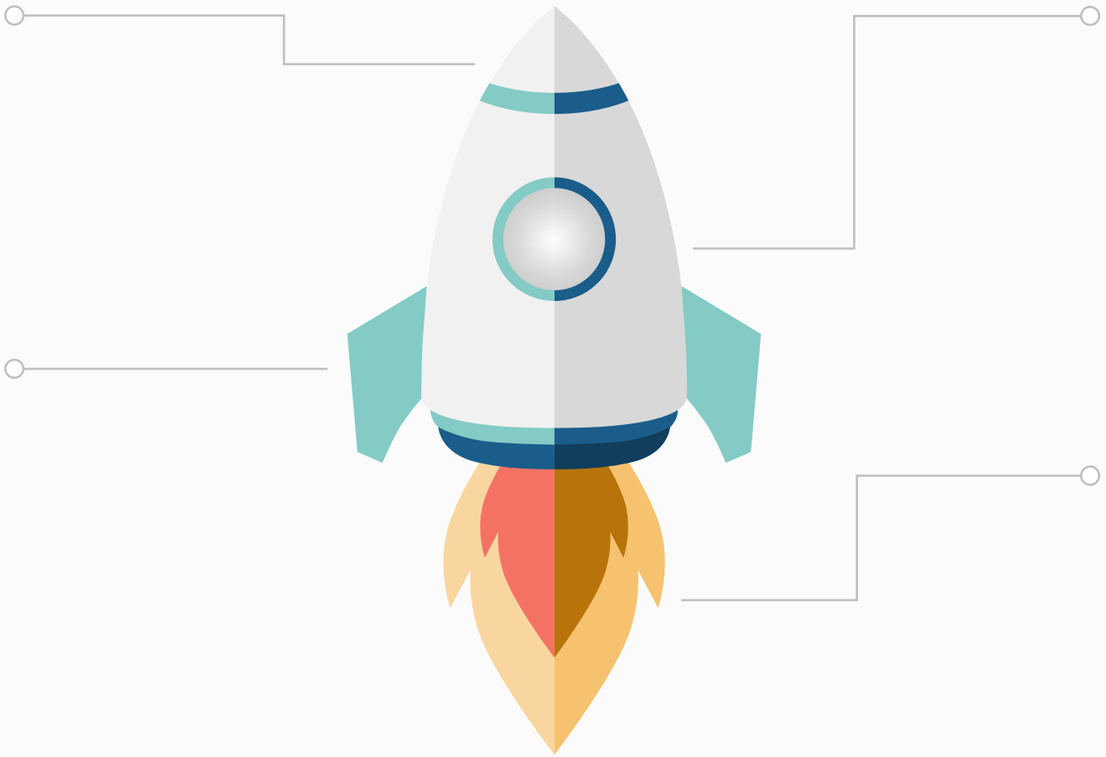
IFRS 17 has new and complex requirements which allows companies who missed the boat for SII to reassess their databases and systems.

Various Formats

- Legacy data are in various formats and forms, which is a problem in itself

Incomplete

- Additional approximation or implications are required
- Assumptions on past experiences are not readily available and need to be reconstructed from database



Uncontrolled

- Legacy models often do not have proper governance around ETL

Output

- Legacy model output is not likely to be compatible with IFRS17 requirements (e.g. fees and expenses definition)
- As a result, the actuary needs a more flexible system to meet the changing and evolving regulatory requirements

Data Challenges Big Data Problems

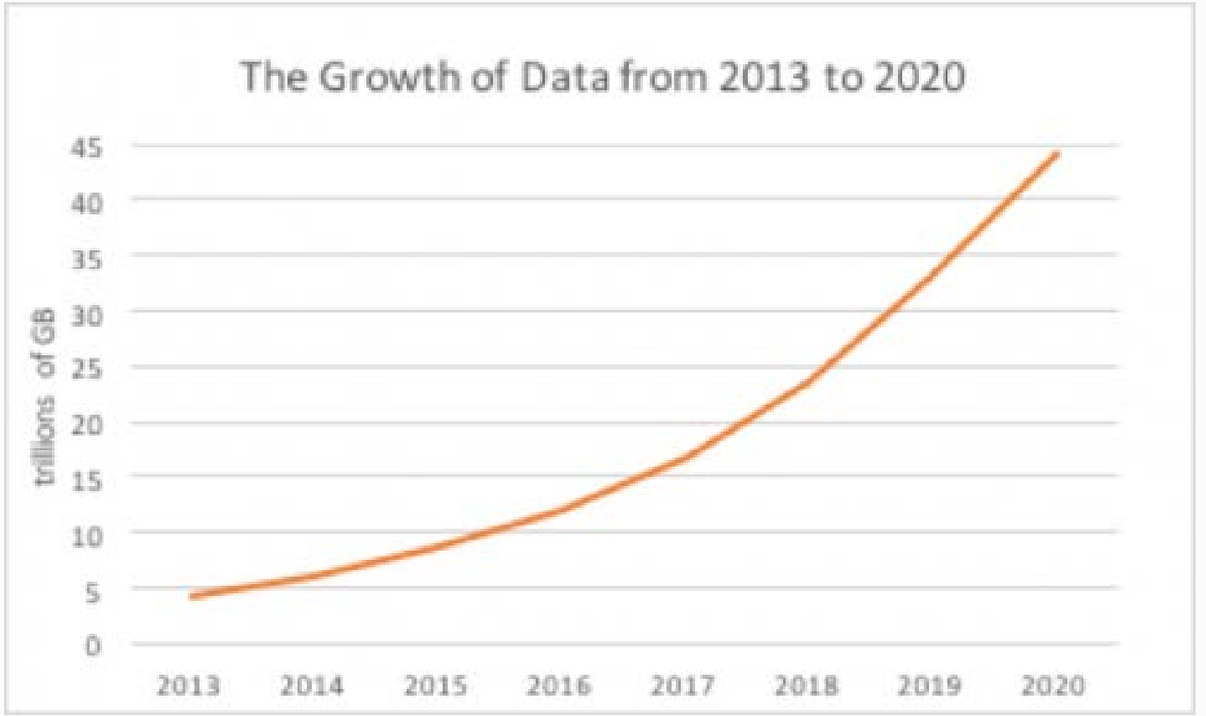
Big Data

(Re)insurance companies do not use petabytes of data to calculate their provisions, more data is expected to be required for provisioning and for pricing under IFRS17. This leads to architectural changes and challenges in:

- Storage
- Centralization
- Archive Data warehouse
- Data snapshots

The amount of data that needs to be saved includes:

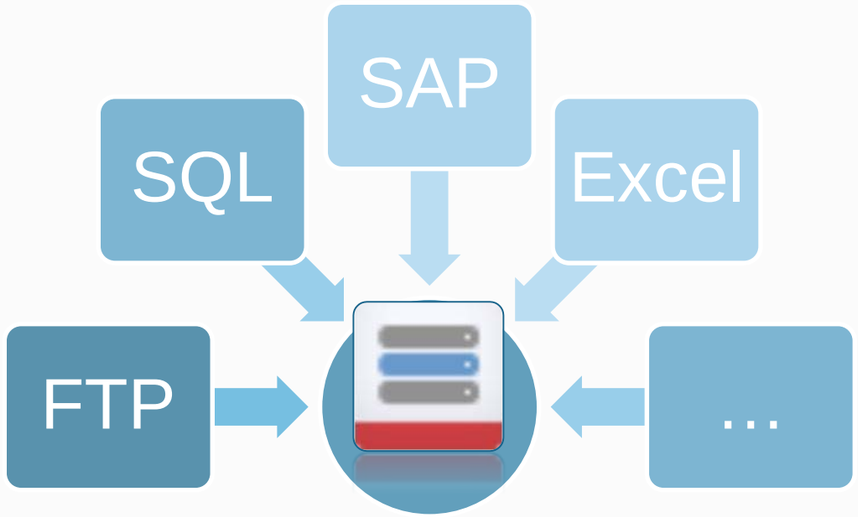
- Assumptions
- Policy and / or Model Points
- Actual vs Expected Cash Flow for movements
- Sensitivity analysis
- Historical asset data
- CSM evolution



Case Study Korean Implementation

Data Challenges in Korean Implementation

- **Hundreds of Gigabytes** of **input data** such as inforce data and assumptions with different formats need to be transferred to the IFRS17 Data Warehouse within a few hours by agreeing on a schedule with the data provider **every month.**
- **Multiple Terabytes** of **output data** such as policy level cash flows need to be stored back to IFRS17 Data Warehouse for movement analysis purposes **every month**.
- IFRS17 standard **financial statements** need to be produced **within 24 hours**.
- The data source needs to be combined into a centralized database as required with appropriate access rights for easy system interacting. All data needs to be stored in IFRS17 Data Warehouse **for 5 years**.
- Within the legacy databases and network, costs to fulfill the above business requirements will be **very expensive**.



IFRS17 Data Warehouse

06

Suggested Solutions

Suggested Solutions Integrated

Integrated Platform

Orchestration

IFRS planning is much more do-able using only one modelling platform

One Platform

Liability valuation, product development, asset liability management, business planning, hedging, and economic scenarios generation can be conducted in one actuarial model platform.

Governance

IFRS is accountancy driven

One Platform

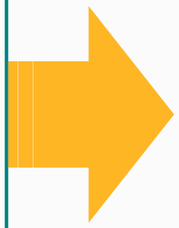
One model can be shared cross different departments with different permission and strong version controls. All inputs and outputs can be generated, stored and traced within one platform with clear audit trail.

Suggested Solutions Integrated

Our approach: One Model, One Platform.

Sample Current State

Vendor 1	Liability Adequacy Test
	Embedded Value
Vendor 2	Variable Guarantee
Vendor 3	Cash Flow Pricing
Excel	Asset Liability Management
	Business Planning
Vendor 4	Variable Guarantee Hedging

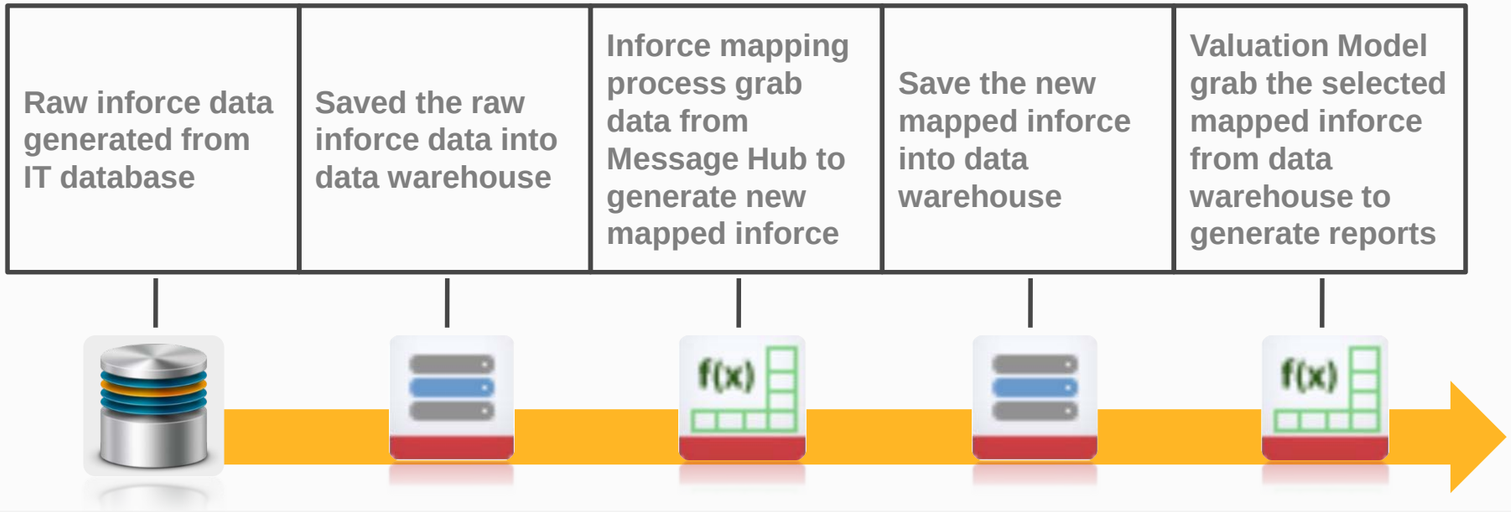


One Platform

- A jigsaw puzzle of systems
- And the worst part is so many jigsaw pieces are missing!
  - ✓ Data flows, security, hardware and hosting, version control, job scheduler, intelligent automation, different levels of flexibility, speed and transparency, etc.
- An puzzle today quickly turns into an orchestration nightmare tomorrow

Suggested Solutions Automation

IFRS 17 Data Warehouse



- Data Warehouse help establish consistent inforce management system
- All previous version of inforce are available
- Easily lookup and analyze current vs previous inforce changes
- Provides auditing trail
- inforce are separated by date

IFRS17 data warehouse needs to be built such that it is “big data” compatible on day one

Suggested Solutions Intelligent Automation

IFRS17 Operational Support

Automation for Data Management

Automation for Report Generation

End-to-end fully automated IFRS operation

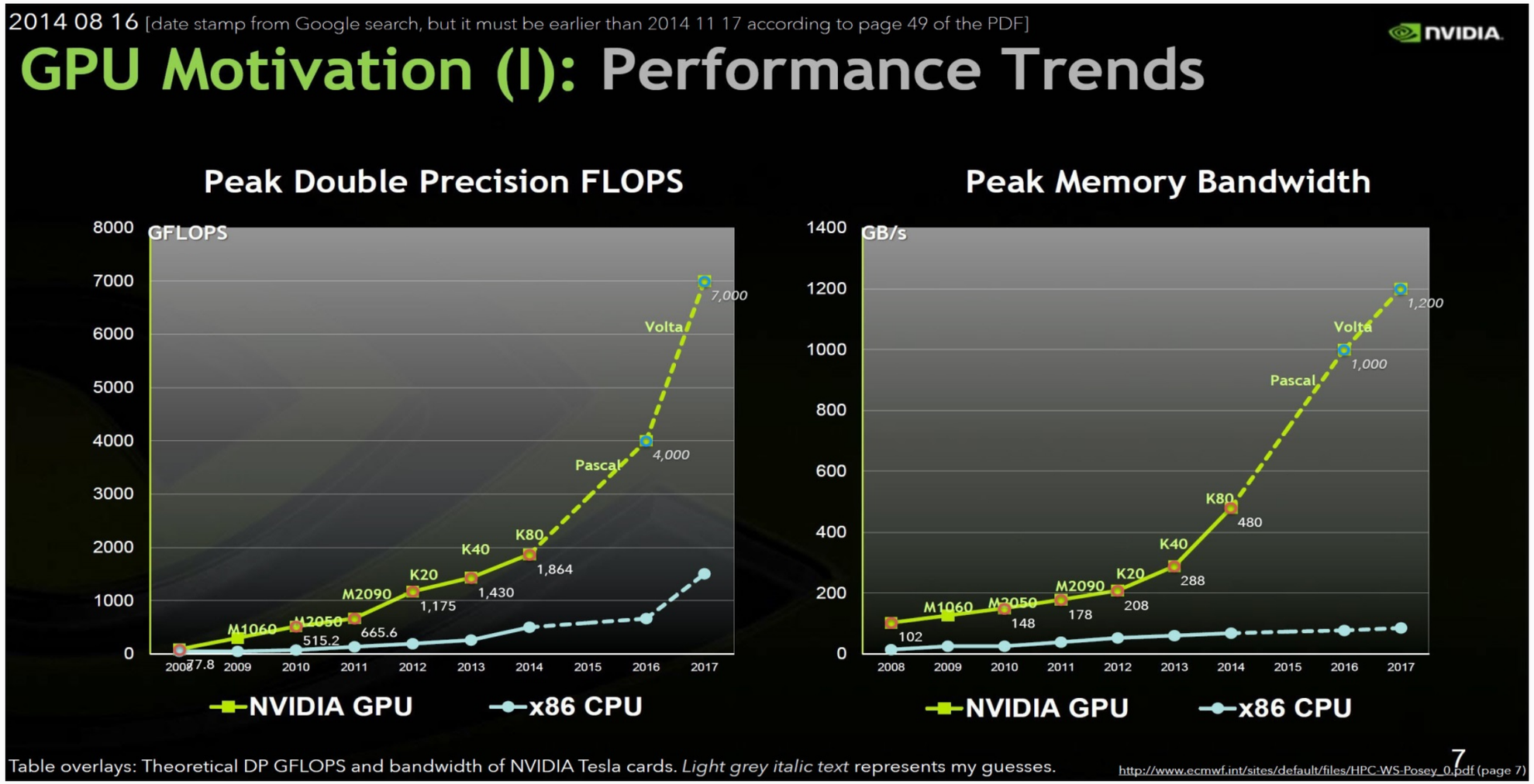
IT System 1:00am	Transfer Folder 2:00am	ETL Script 3:00am	Message Hub 4:00am
▪ Raw policy data generated from IT database ▪ Pass the raw inforce to transfer folder	▪ Validate file and data format ▪ Trigger ETL script	▪ Process raw data ▪ Convert data into Python data format ▪ Upload npz data to Message Hub	▪ Data saved in Message Hub can then be reused by other PathWise applications

Message Hub 5:00am	Job Scheduler 6:00am	GPU Server 7:00am	Reports 8:00am
▪ Database for all assumption and market data	▪ Automatically detect if the inputs file are ready ▪ Run models and reporting scripts	▪ Convert PWMS to GPU code ▪ Process model calculations in GPU server	▪ IFRS CF, Solvency Capital ▪ Profitability Analysis

Suggested Solutions Using the right Hardware

GPU Technology

Intel CPU vs NVIDIA GPU Speed comparison



There are 8~16 units in each CPU core, but there are more than 3,500 units in each GPU. So a GPU has lot more processing units than a CPU. Having many cores is very effective for high performance parallel computation, which is required for SoS or many policy records.

Suggested Solutions Flexible Deployment

IT Infrastructure

Different types of infrastructure solutions

Solution	Expenses	Level of Control	Compliancy	Support
On-Premise	Software technology licensing	Customer takes full control of the server and IT infrastructure	Compliant with company specific IT security protocols	Software support Service Level Agreements
SaaS	Complete turn-key solution (Software-as-a-Service)	Service Level Agreement (SLA) guaranteed operations	Compliant with industry standards, regulations, and best practices	Third-party Audited
Hybrid	Disaster recovery or portion of their servers running in the cloud to reduce operational risk	Minimal business interruption in unforeseeable events	Depends on the companies setup	Satisfies data storage and redundancy requirement set out by regulators

A Fully Transparent Solution

01 DATA & COMPUTATION

All inforce data, assumptions, and results can be accessed in one database application for all departments with different permissions for different environments.

02 REPORTING

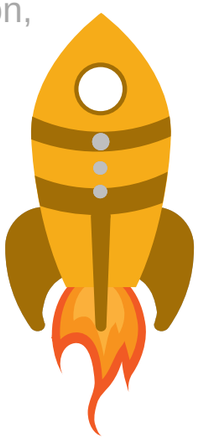
All financial reports can be read from one reporting application, easy to find all corresponding inputs, correct errors and rerun.

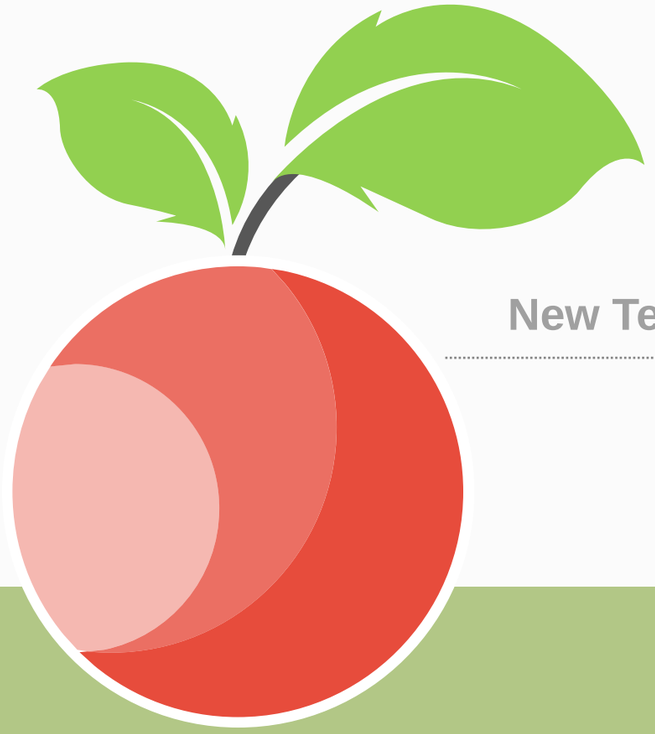
03 AUDITABLE

Transparent platform should have strict governance. All model logics can be read in one modeling application, flexible to modify with strong version control.

100% transparency

Third-party auditors can see all audit trails in a single actuarial platform.





New Technology | Innovation | Creativity

FEASIBLE APPROACH

If the current system cannot meet your needs, why not consider to look for a new one?

CLOUD BASE
cloud solution allows user to eliminate the hardware requirement and save the hardware maintenance cost.

GPU vs CPU
cutting edging GPU technology eliminates running time concerns.

AUTOMATION
streamlined automatic process, minimal probability of human errors.

INTEGRATION
integrated system that eliminates conversion work between systems, minimize cost.

Wrap Up

Data & System Challenges and Solutions

IFRS 17 poses NEW **CHALLENGES.**

IFRS 17 requires scenario-based discounting for liability fulfillment cash flows. This impacts the valuation of liability and in turn, ALM. Solvency II requires discounting at the market risk-free rates. Internal models represents the only single solution for satisfying both regulations.

SYSTEM REVAMP?

Insurance companies can leverage this IFRS17 opportunity to revamp the entire actuarial modelling and reporting platform.

INADEQUATE LEGACY BUSINES SOLUTIONS

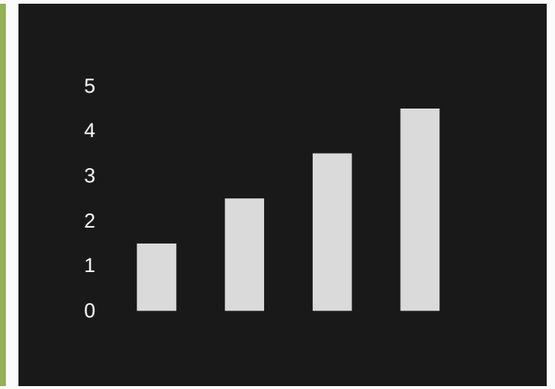
Non-Scalable to peak demands

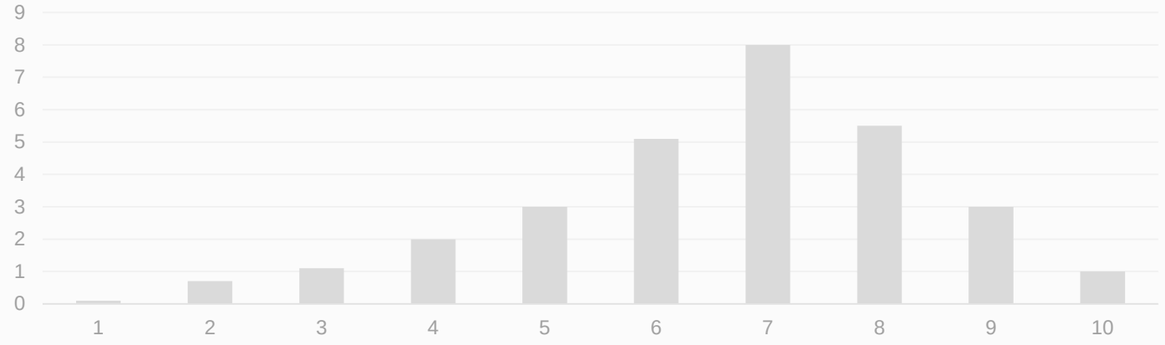
Manual processes that are error prone

Lack of transparency in results and audit trails

USING THE RIGHT HARDWARE

Next generation actuarial platform based on GPU and cloud computation can significantly improve actuarial efficiency on a daily basis.





LETS TALK ABOUT

ORCHESTRATION ☺

There is an ever increasing need to have a flexible, easily understood, and controlled and auditable way to manage data, models, compute, and reports

END OF PRESENTATION