Equity-Based Insurance Guarantees Conference
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Baltimore, MD

Regulatory Change and ALM Systems

Peter M. Phillips

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Regulatory Change and ALM Systems

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

Peter M. Philips

Session 3A: November 6, 2017 3:30 – 5:00 pm
Who We Are?
- Aon Benfield
- PathWise Solutions Group

Market Overview
- IFRS17
- GDPR

System Challenges
- Level of Aggregation
- Future Cash Flows
- Risk Adjustment
- CSM

Outdated Software
- Low Productivity
- Low Performance
- Black Box Solutions

Data Challenges
- Legacy Data
- Data Cleansing
- Big Data Issues

Suggested Solutions
- Platform Integration
- Intelligent Automation
- High Performance
- Flexible Deployment

Equity-Based Insurance Guarantees Conference
Regulatory Change and ALM Systems
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.
A leading capital and strategic advisor with global coverage bringing together 100 years of specialist experience.
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.
Managing New Complexity

- A New Accounting Standard
  - One accounting model for all insurance contracts in all IFRS jurisdictions, replacing IFRS 4
  - **126 out 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

<table>
<thead>
<tr>
<th>Balance sheet</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PV future cash flows (PVFC)</td>
<td>544.65</td>
</tr>
<tr>
<td>Risk Adjustment (RA)</td>
<td>120.00</td>
</tr>
<tr>
<td>Fulfilment Cash Flow (FCF)</td>
<td>664.65</td>
</tr>
<tr>
<td>Insurance contract liability</td>
<td>900.00</td>
</tr>
<tr>
<td>CSM</td>
<td>235.35</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>P&amp;L</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Insurance service expenses</td>
<td>-900.00</td>
</tr>
</tbody>
</table>
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
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
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.**
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/
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:

1. **Product lines for which the block of business is managed together**
2. **Contracts issued within a period of no longer than one year**
3. **Onerous, possibly onerous in the future, and remaining**

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

**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?

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.”
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: $10 \times 20 \times 4 \times 3 = 2400$
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:

\[
\text{Total Projected Cash Flows} = \text{Number of Policies} \times \text{Nested Scenario’s (if explicitly calculating Risk Adjustment)} \times \text{Analysis of Change Runs} \times \text{Policy Years}
\]

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

<table>
<thead>
<tr>
<th></th>
<th>Number of Policies</th>
<th>Nested Scenario’s</th>
<th>Analysis of Change Runs</th>
<th>Policy Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>138 Billion</td>
<td>200</td>
<td>1000*1000</td>
<td>23</td>
<td>30</td>
</tr>
</tbody>
</table>

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

- Market Value of Assets (MVA)
- Solvency Capital Requirement (SCR)
- Risk Margin
- Best Estimate of Liabilities (BEL)
- Excess Capital

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

FRS17—Liability

- Contractual Service Margin
- Risk Adjustment
- Discounted probability weighted estimate of fulfilment cash flows
- Contract Liability

Own Funds is the difference between MVA and MVL.

Risk Margin

Both Parts are simulated with

\[ RM_t = 6\% \times \sum_{k=0}^{T} \frac{SCR}{D_k} \]
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 policies 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.
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

It’s great to get 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
Proprietary & Confidential

Real World Scenarios

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

Risk Neutral Scenarios

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

\[
1000 \times 30 \times (22 + 1) \times 1000 = 690 \text{ Million Calculation (Per Policy)}
\]
## Case Study: Korean Implementation

### Variable Universal Life Pricing Example

#### Results

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

<table>
<thead>
<tr>
<th>Total Projected Cash Flows</th>
<th>Number of Policies</th>
<th>Nested Scenario’s</th>
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<td>200</td>
<td>1000*1000</td>
<td>23</td>
<td>30</td>
</tr>
</tbody>
</table>

**Results Table**

<table>
<thead>
<tr>
<th></th>
<th>1000x CPUs</th>
<th>60x GPUs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Projection</td>
<td>138 Billion</td>
<td>138 Billion</td>
</tr>
<tr>
<td>Speed (per sec per core)</td>
<td>400 Scenarios</td>
<td>160,000 Scenarios</td>
</tr>
<tr>
<td>Total Run Time</td>
<td>96 hours (4 days, estimate)</td>
<td>4 hours</td>
</tr>
</tbody>
</table>

*1000x CPUs and 60x GPUs refer to the number of CPUs and GPUs used for the analysis.*
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
(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.
06
Suggested Solutions
Proprietary & Confidential

Suggested Solutions Integrated

**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.
Proprietary & Confidential
Suggested Solutions Integrated
Our approach: One Model, One Platform.

Sample Current State

<table>
<thead>
<tr>
<th>Vendor 1</th>
<th>Liability Adequacy Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Embedded Value</td>
</tr>
<tr>
<td>Vendor 2</td>
<td>Variable Guarantee</td>
</tr>
<tr>
<td>Vendor 3</td>
<td>Cash Flow Pricing</td>
</tr>
<tr>
<td>Excel</td>
<td>Asset Liability Management</td>
</tr>
<tr>
<td></td>
<td>Business Planning</td>
</tr>
<tr>
<td>Vendor 4</td>
<td>Variable Guarantee Hedging</td>
</tr>
</tbody>
</table>

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

- 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
End-to-end fully automated IFRS operation

**Automation for Data Management**

- **IT System 1:00am**
  - Raw policy data generated from IT database
  - Pass the raw inforce to transfer folder

- **Transfer Folder 2:00am**
  - Validate file and data format
  - Trigger ETL script

- **ETL Script 3:00am**
  - Process raw data
  - Convert data into Python data format
  - Upload npz data to Message Hub

- **Message Hub 4:00am**
  - Data saved in Message Hub can then be reused by other PathWise applications

**Automation for Report Generation**

- **Message Hub 5:00am**
  - Database for all assumption and market data

- **Job Scheduler 6:00am**
  - Automatically detect if the inputs file are ready
  - Run models and reporting scripts

- **GPU Server 7:00am**
  - Convert PWMS to GPU code
  - Process model calculations in GPU server

- **Reports 8:00am**
  - IFRS CF, Solvency Capital
  - Profitability Analysis
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.
## Different types of infrastructure solutions

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

80% transparency
Third-party auditors can see all audit trails in a single actuarial platform.
If the current system cannot meet your needs, why not consider looking 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.
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 represent 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 BUSINESS 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.